DELAY OF DIAGNOSIS AND TREATMENT OF NEW SMEAR POSITIVE PULMONARY TB IN RURAL AREA GAZIERA STATE, SUDAN

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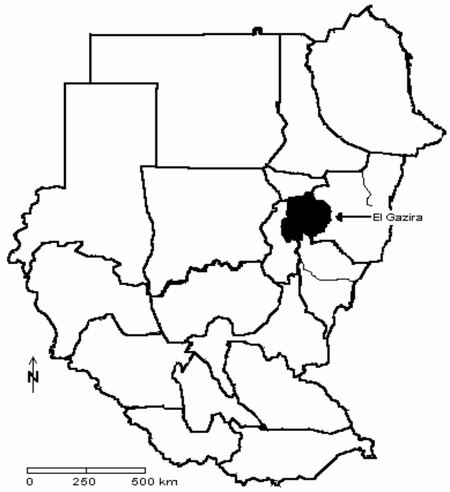

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June 2006

Thesis submitted as a part of the
Master of Philosophy Degree in International Community Health

ABSTRACT

DELAY OF DIAGNOSIS AND TREATMENT OF NEW SMEAR POSITIVE PULMONARY TB IN RURAL AREA; GAZIERA STATE, SUDAN

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Background: The basics of TB control are based on early detection and treatment of infectious cases. Early detection is controlled by both patient's and health system's factors. In this study we explored some of both patient's and health system's factors that contributed to longer period of infectiousness of TB. **Objectives**: The overall goal of this study was to determine the magnitude of both total delay and total period of TB diagnosis and initiation of anti TB treatment and to investigate the possible contributing factors. **Setting**: All levels of health services within Gaziera State, Sudan. 77% of population was rural settled during the last 3 centuries after a past history of nomadic life. The population is multi ethnic and multi cultural. **Design**: A quantitative cross sectional study during the period 17th of July 2005 to 11th of January 2006. **Results**: Two hundred and sixteen new smear positive pulmonary TB patients were recruited. The mean total diagnostic period was 69.66±28.14 days. 87.5% delayed for more than 42 days. Risk factors for long mean total diagnostic period were being divorced or widow, family monthly income more than 100 US$, other health providers visited before TBMU and having to pay for services in public health facilities. The mean patient's period was 36.6±23.13 days. 61.6% was delayed for more than 1 month. Risk factors for long mean patient's period were being 25-54 years old, being alone in a room in the house, distance more than 30 minutes walk to TBMU and sputum for AFB grade scanty or 1+. The mean total health system's period was 33.05±24.5 days. 79.2% were delayed for more than 2 weeks. The mean other health provider's period was 29.1±24.7 days. 78.7% were delayed for more than 9 days. The risk factors for long means total health system's and other health provider's period were being of female gender, divorced or widow, students or without income generating activity, family monthly income more than 100 US$, distance between 15 to 30 minutes walk to TBMU, blood investigation performed, more than one other health provider consulted and having to pay full fees or being covered by health insurance to the public health facility. The mean TBMU's period was 3.99±1.6 days. 14.8% were delayed for more than 5 days. Risk factors for long mean TBMU's period were being 25-54 years old, living alone in a room in the house, distance between 15 to 30 minutes walk to TBMU and sputum for AFB grade 2 ++. The mean post referral period was 4.32±6.87 days. Risk factors for long post referral mean period were being older than 25 years, divorced or widow, higher level of education, rural residence, free access to public health facility and sputum for AFB grade 2 ++. **Conclusion**: Delay of TB diagnosis and treatment was highly prevalent in this area. Both patients and health system share an equal responsibility. Patient's factors can modulate health system's period while health system factors play the same role for patient's period. For patients, socio demographic factors played a crucial role in modulating the diagnostic period. For the health system, other health provider's practice toward TB suspect played a role. Economical factors were found to contribute to both periods i.e. health system and patient. More researches to explore socio demographic bases influencing patient's period should be conducted while coordination between TBMUs and other health providers should be the focus of TB control in the future. Poverty reduction policies would be a crucial factor as a contributor to shorten total diagnostic period. Evaluation of new TB diagnostic tools should put in consideration the overlapping of patient's and health system's periods, like post referral period.

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List of abbreviations

AFB	Acid Fast Bacilli
ARI	Annual Risk of Infection
DOTS	Directly Observed Treatment Short Course
FMOH	Federal Ministry of Health
GDP	Gross Domestic Product
HIV	Human Immune Deficiency Virus
IDPs	Internally Displaced Populations
IUATLD	International Union against TB and Lung Diseases
MDR	Multi Drug Resistant
NGOs	Non Governmental Organizations
NTP	National TB Control Programme
PHC	Primary Health Care
SMOH	State Ministry of Health
TB	Tuberculosis
TBMUs	Tuberculosis Management Units
WHO	World Health Organization

Acknowledgment

I would like to express my gratefulness to the institute of international community health, university of Oslo, Norway as represented by my supervisor Prof. Gunner Bjune, Ane and Vibeke for the support they gave to me.

To the staff of EpiLab, Sudan represented by my co supervisor Prof. Asma I. El Sony, to Mohammed, Maaz, Imad, Mai, Safa, Shadya and Ammar Khamis for giving me their time and being so generous providing advices and knowledge.

I would like to convey my appreciation to all TB patients, especially in Gaziera State and to the state team as represented by Dr. Hassan, Bushra, Amani, Adam, Elhadi, Mustafa, Khider, Mohammed, Saead, Hassan Hammad and El Tybe Abbas for helping me collecting my data.

I would like to thank my friend Fourawy, my corridor family in Kringsja (Christina, Luana, Thanos and Sekou) and my Sudanese family in Oslo (Abdulla, Ali, Abbas, Kamal, Sufyan and Renas) for supporting me socially, mentally and technically.

Finally I would like to express my special respect and gratefulness to the Quota programme for giving me this chance and appreciation to Michele for her patient and organizational skills.

Dedication

To My

-Father-

-Mother-

-Sisters-

And

-Brothers-

1. Introduction

Tuberculosis (TB) transmission depends upon exposure to tubercle bacilli. One of the three major factors that determine the risk of becoming exposed is the duration of the infectiousness of an index case in the community (1). Without treatment 50% of patients will die within 5 years. And the patient Become a source of infection and on average will infect 10 to 15 peoples per year.

One of the main objectives of TB control is to reduce transmission through early detection and rapid administration of proper anti-TB treatment. Although this seems to be very simple and straight forward but the situation is complicated. Patient's seeking behaviors, coverage and accessibility of TB services, sensitivity of sputum examination to detect TB and maintenance of a high suspicion index by health workers were among the most important factors that may hamper the process of early detection. The problem of delay in initiating anti-TB treatment is one of the major challenges facing the global efforts in TB control. Many studies revealed existence of considerable delay either on the patient's or the health system's sides.

The efforts of TB-control in Sudan resulted in implementing the national TB control programme in the mid-nineties. The expansion of TB services achieved 100% coverage, but the pre-treatment periods for most smear-positive cases in urban and suburban areas still ranged between 6 to 9 weeks. Important aspect of this problem is the immature relation between the public TB services and other medical providers in the public or the private sectors. Several studies from different countries showed that TB patients' health seeking behaviour share the responsibility for long delay. Also, some of these studies showed lower suspicion indices among non TB health facilities and under-utilization of essential investigations like sputum examination and X-ray. Most of the studies were done in urban and suburban areas where we may expect lower degree of delay in the diagnosis of TB when compared with rural areas. In rural settings health facilities are not of the same quality and people in a rural setting do have their own initiative behaviour and practice concerning diseases. Some of those practices may affect the early diagnosis and treatment of TB. In this study the setting was a rural area of Sudan, a population which was not investigated before concerning delay in the diagnosis of TB.

2. Literature Review

2.1. Sudan profile

Since independence from the UK in 1956 Sudan was embroiled in two prolonged civil wars. These conflicts were rooted in the country economic, political, and social domains. The first civil war ended in 1972, but broke out again in 1983. The second war and famine-related effects resulted in more than 4 million displaced people and, according to some estimates, more than 2 million deaths over a period of two decades. The Final Naivasha Peace Treaty of January 2005 granted peace in the south Sudan. A separate conflict that broke out in the western region of Darfur in 2003 has resulted in at least 200,000 deaths and nearly 2 million displaced; as of late 2005, peacekeeping troops were struggling to stabilize the situation. Sudan also has faced large refugee influxes from neighboring countries, primarily Eritrea, Ethiopia and Chad, and armed conflict and poor transport infrastructure (2).

Geography

Sudan is located in Northern Africa, bordering the Red Sea, between Egypt and Eritrea. With a total area of 2,505,810 sq km, Sudan is the largest country in Africa; dominated by the Nile and its tributaries. The climate is tropical in south; arid desert in north; rainy season varies by region (April to November). The terrain is generally flat, featureless plain; mountains in far south, northeast and west; desert dominates the north. Natural resources includes petroleum; small reserves of iron ore, copper, chromium ore, zinc, tungsten, mica, silver, gold and hydropower (2).

The cultivable area in Sudan is estimated at about 105 million ha (42 % of the total land area), while in 2002 the cultivated land was 16.65 million ha (7 % of the total land area and 16 % of the cultivable area), comprising 16.23 million ha arable land and 0.42 million ha under permanent crops. Sudan has the largest irrigated area in sub-Saharan Africa and the second largest in the whole of Africa, after Egypt. Rain fed agriculture covers by far the largest area in Sudan (3).

Demography

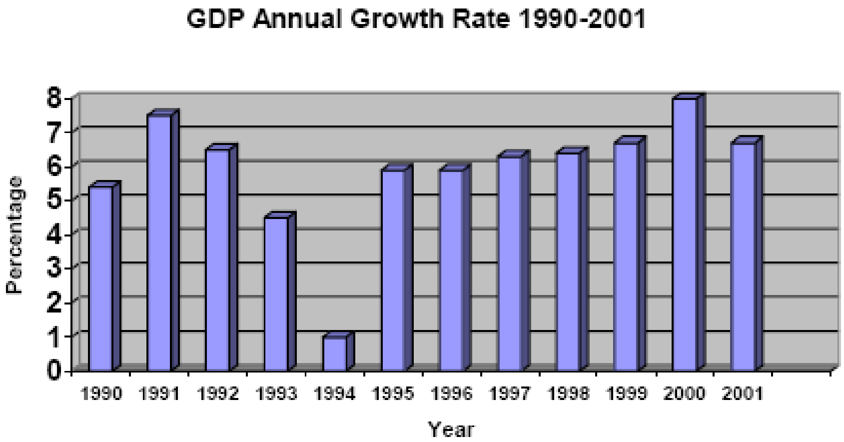
The total population of Sudan is 41,236,378 (2005 estimation.). The age structure of which is as follow; those 0-14 years: 42.7% (male 8,993,483/female 8,614,022); 15-64 years: 54.9% (male 11,327,679/female 11,297,798); 65 years and over: 2.4% (male 536,754/female 466,642). The median age for the total population is 18.3 years, for male are 18.1 years and for female is 18.5 years. Sex ratio for the total population is 1.02 male(s)/female, at birth is 1.05 male(s)/female, under 15 years is 1.04 male(s)/female, 15-64 years is 1 male(s)/female and 65 years and over is 1.15 male(s)/female. Infant mortality rate for the total population is 61.05 deaths/1,000 live births, for males are 61.88 deaths/1,000 live births and for females are 60.18 deaths/1,000 live births. Life expectancy at birth for the total population is 58.92 years, for males is 57.69 years and for females is 60.21 years. Literacy as defined by age 15 and over can read and write, for the total population is 61.1%, for males is 71.8% and for females is 50.5% (2).

In Sudan there are more than 139,000 refugees and between 5.3 to 6.2 millions of internally displaced persons (IDPs).

Economy

Sudan has turned around a struggling economy with sound economic policies and infrastructure investments, but it still faces formidable economic problems, starting from its low level of per capita output. From 1997 to date, Sudan has been implementing international monitory fund macroeconomic reforms. In 1999, Sudan began exporting crude oil and in the last quarter of 1999 recorded its first trade surplus, which, along with monetary policy, has stabilized the exchange rate. increased oil production, revived light industry, and expanded export processing zones helped sustain gross domestic product (GDP) growth at 8.6% in 2004 (GDP $2,100, 2005 estimation). Agricultural production remains Sudan’s most important sector, employing 80% of the work force, contributing 39% of GDP, and accounting for most of GDP growth, but most farms remain rain-fed and susceptible to drought. Chronic instability - resulting from the long-standing civil war, adverse weather, and weak world agricultural prices - ensure that much of the population will remain at or below the poverty line (40%, 2004 estimation) for years (2).

Figure 2.1: figure shows GDP annual growth rate 1999-2001 in Sudan



Source: Ministry of Finance

Political context

The government adopted the federal system in 1994. Decentralization was introduced as a system of governance compatible with the needs of the multi-ethnic and multi-cultural society of Sudan. The country is divided into 26 states and 134 provinces.

The system is founded upon a multi-tier government: federal, state and local governments. The federal level is concerned with policy making, planning, supervision and co-ordination. The state governments are empowered for planning, policy making and implementation at state level. A number of problems appeared during the implementation of the federal system, the most prominent being uneven distribution of financial resources and manpower between states and between rural and urban areas (4).

2.2. The health system in Sudan

The following discretion of health system in Sudan is adopted from the report of expert committee on the health gaps in Sudan (4).

General Organization

Sudan has 26 State Ministries of Health (SMOH), one in each State. The Federal Ministry of Health (FMOH) is responsible for the development of national health policies, strategic plans, monitoring and evaluation of health systems activities. The SMOH are mainly responsible for policy implementation, detailed health programming and project formulation. The implementation of the national health policy is undertaken through the district health system based on the primary health care concept.

Government spending on health has remained at less than 1% of GDP. Both in absolute and relative terms – at perhaps US$4 per capita and under or around 1% of GDP – government health spending in Sudan ranks among the lowest in the world.

Health services are provided through different partners including in addition to federal and state ministries of health, armed forces, police security, universities, private sector (both for profit and philanthropic) and civil society. However, those partners are performing in isolation due to ill defined managerial systems for coordination and guidance.

The adoption of the decentralized system in Sudan was faced with many problems arising from the abrupt implementation without prior effective training programmes. The qualifications of many of the senior staff at state ministries of health are irrelevant to the assigned jobs. The federal rules, although comprehensive, are not equally understood at the state level. Moreover, lack of mechanisms to identify, analyze and solve problems has led to accumulation of many unsolved problems. There is no system for experience exchange between different states. The main problems with the organizational structures in the governmental health services at different levels are:

- Rigidity of the organizational structure.
- Poor coordination between departments (4).

The organizational pattern of the health care delivery system

The organizational pattern of the health care delivery system could be described as three leveled-systems (primary, secondary and tertiary). The primary level is composed of the primary health care (PHC) units and dispensaries. The PHC units are usually staffed by the community health workers and dispensaries are staffed by medical assistants and nurses. The secondary level of the system is composed of the health centers and the rural hospitals, which are usually staffed by physicians, medical assistants, nurses and other paramedical staff. In principle the secondary level is supposed to be the first referral level for the primary level. It has to be emphasized that the system is not uniform and variations do exist especially in the worse-off states and localities. Urban-rural variations do also exist. The tertiary level is composed of state hospitals, teaching, specialized and university hospitals (4).

Health policy & strategy

Sudan country strategy note 1992-2002 (CSN) outlines the national health policies. The strategy recognizes the welfare of people as the ultimate goal of all development. Furthermore, it recognizes health as a right of all citizens, emphasizing the high priority to women and children.

The main goal was to improve equity by generalizing the provision of basic health care to include prevention, treatment and rehabilitation. Very ambitious objectives and targets were adopted including among others; reducing infant mortality to 20 per 1000 live births; providing maternal health care throughout the country; eradicating epidemic and endemic diseases and achieving 100% immunization coverage; making essential medicines available to all and establishing the national industry for medical equipment and supplies and drugs; developing human resources for health and reducing absenteeism at work; and updating health information systems and improving health education and awareness.

During the 1990s the health policies and strategies were subjected to the effects of decentralization and public reforms. Within the health sector, the government aiming to achieve health development adopted new approaches and mechanisms. These include; cost sharing, health insurance and private sector, which drastically affect the overall performance of the health care delivery. Thus it would be unfair to visualize the health care delivery system and its development without objectively considering all these factors. not only this but other issues such as inflation, the civil war expenses, the migration of the health personnel, the questionable capacity of the state and local levels to overtake the responsibility of the health system and service delivery have contributed markedly in disabling the system.

In 1994, the federal act subdivided the country into 26 states, and each state was subdivided into provinces. Recently the government restructured the system and the provinces were canceled and replaced by the localities. As a result of the restructuring, the number of localities mounted to 134. The current organizational pattern of the health

sector is composed of the FMOH and 26 SMOH. At the locality (provinces) level, the health area system was introduced.
From the managerial point of view, the decentralization reform is considered as an advanced step to improve the performance of the health care delivery system, provided that the state and local levels capacities and capabilities were adequately strengthened.

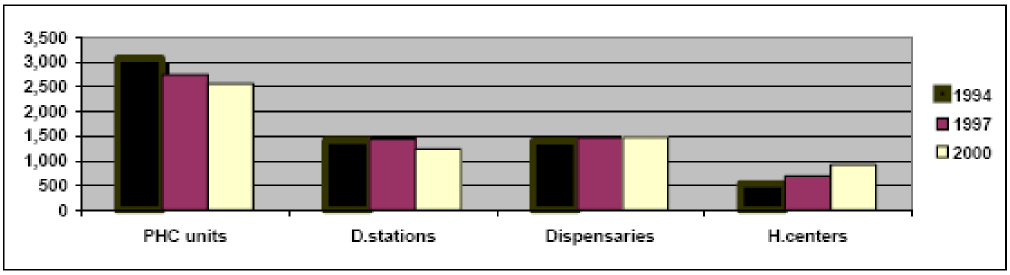
Less than half of the localities (provinces) have functioning health area system in place, and only 19 are reportedly working according to the policy. A recent study of four health areas found them non-operational and non using budget. The impression given by the available information is that in the poorer states, it is vertical programs, such as those for malaria and TB, which have most resources and are most functioning (4).

Infrastructures

As shown in the figure2.2, the number of PHC units and the dressing stations (D. stations) is declining over the period from 1994 to 2000, as some of these facilities were closed (due to; lack of staff, lack of recurring costs, and the concentration on the higher level). Currently there are about 2558 PHC units and 1236 dressing stations, mostly in the rural areas. On the other hand, the number of dispensaries and health centers (H. centers) has increased over the same period. The current number of dispensaries and the health centers across the country is 1475 and 915 respectively. This could be justified by the tendency to replace the PHC units and dressing stations by higher well-equipped facilities considering the changes in the perceived needs of the communities especially in the rural areas.

The performance of the health care delivery system could be examined through assessing the urban: rural ratios of the facilities, the population served per facilities in the rural and urban areas and the distribution of the facilities within the each state.

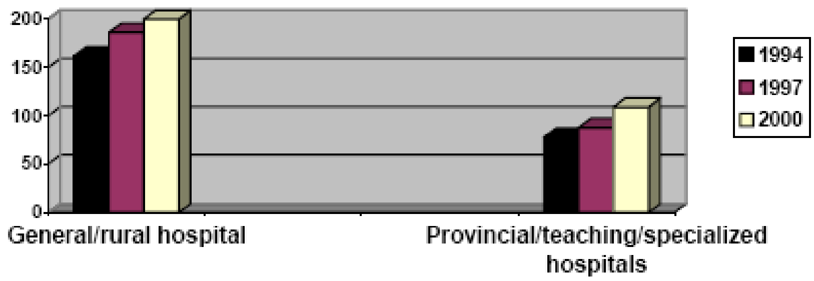
Figure (2.2): Primary and secondary governmental health facilities: 1994-2000



Source: Federal Ministry of Health

As seen in the figure 2.3, the general/rural hospitals increased and the provincial, specialized and teaching hospitals also increased in number during the period 1994-2000. The current number of the rural/general hospitals is 200 while the number of the other provincial specialized and teaching hospitals is 109 across the country. Significant disparities are evident in the geographical facilities. Many rural areas are underserved by health system, as functional facilities, in particular health centers and hospitals, are clustered in towns and cities. There are also significant differences between poorer and better off states. For example, there are 5.2 hospitals and 246 beds per 100,000 populations in the Northern states, compared to 0.2 hospitals and 14 beds per 100,000 in South Drafur. The overall averages are 1 hospital and 74 beds per 100,000 (4).

Figure 2.3: shows changes in number of public health facilities 1994, 1997 and 2000



Human resources

According to the statistical report of the year 2002, there were 5,765 doctors (962 specialists), 210 dentists, 302 pharmacists, 27,583 nurses and midwives.

The number of nurses and general practitioners has declined in relation to population growth.

The total number of nurses, after declining in the mid nineties, has increased by only 3.4 percent over the last decade (equivalent to a rate of only 0.3 % per annum) and the number of general practitioners has increased by only 2.7 % (a rate of 0.6 % per annum). On the other hand the number of midwives has increased by 75 % (a rate of 5.2 % per annum). These changes are to be compared with the growth in Sudan's population during the nineties of about 2.6 % per annum. Evidence indicates that staffing in rural areas is much weaker compared with urban areas. The main reasons are the substantially lower incentives and employment conditions for health care professionals working in rural areas compared to urban areas. Again, rural areas are less well served than urban areas (4).

Private sector (profit and non profit)

The private sector in Sudan has expanded during the last few years especially in towns and better-off rural areas; however the magnitude of the service provided is unknown. It focuses on curative services and has little role in preventive interventions such as vaccination. Public practitioners are allowed to practice in the private sector in addition to their work in public facilities. The bulk of the private health care facilities are clinics. Private secondary and tertiary care expansion is limited to few states like Khartoum and Gaziera States. The quality and prices of care is often criticized, although it is perceived by the users to be better than government services.

There is deficiency in the available information about non governmental organizations (NGOs) working in Sudan regarding their plans, budget and distribution. However they play an important role in filling some of the gaps in coverage of the government system and serving populations which are not attractive markets for the private providers such as IDPs. There is no clear national policy towards NGOs and the monitoring and coordination mechanisms are weak (4).

Sources of health System finance

Available information indicates that spending is highly skewed towards the better off. Regional disparities resulted following decentralization due to lack of financial resources and managerial capacities. This led to deterioration of the PHC system particularly in rural and peripheral areas. Government spending used to be focused on hospitals leading to an unbalanced health system. An out-of-pocket payment benefits the better off and so is spending for care abroad. Health insurance system covers only 8% of the population, most of whom are governmental employees (4).

Summary of health Services problems

The health system in Sudan, despite forming and reforming is still suffering from many problems, summarized as follows:

- Absence of referral systems
- Lack of means of patients transport and ambulances
- Lack of quality work standards
- Service is not based on the concept of client satisfaction
- Weak infrastructure and distribution
- Lack of clear vision, mission and plans
- Many health facilities are not constructed according to the recommended standards for its location, buildings…etc
- Low quality of tertiary services leading to patients seeking treatment abroad
- Weakness of integration between curative and preventive services leading them to work in isolation.
- Weakness of integration between public and private sectors (4).

2.3. Social background of community under study

There was no native, settled, population in the Gaziera area. All the population of the area was from settled groups from different parts of the country. Duration of settlement and ethnicity played a major role on the current social picture of Gaziera area.

Distinctions may be drawn among long-settled communities, those settled in the past half century, and those-- the minority--that remained nomadic or semi nomadic. Recently settled groups might still participate in nomadic life or have close connections with nomadic kin. Formerly, where long-settled and nomadic or Bedouin communities came in contact with each other, relations were hostile or cool, reflecting earlier competition for resources. More recently, a degree of mutual dependency have developed, usually involving exchanges of foodstuffs. Along the White Nile and between the White Nile and

Blue Nile, sections of nomadic tribes had become sedentary. This transition occurred either because of the opportunities for profitable cultivation or because nomads have lost their animals and turned to cultivation until they could recoup their fortunes and return to nomadic life. Having settled, some communities found sedentary life more materially rewarding. Sometimes nomads lacking livestock worked for sedentary people, and where employer and employee were of the same or similar tribes, the relationship could be close. It was understood that when such a laborer acquired enough livestock, he would return to nomadic life. In other cases, a fully settled former nomad with profitable holdings allowed his poorer kin to maintain his livestock, both parties gaining from the transaction.

In principle, all units of the community from the smallest to the largest are based on patrilineal descent. The largest entity is the tribe. A tribe is divided into sections, and each of these, into smaller units. If a tribe were small, it became a *Naziriyah* (administrative unit); if large, its major sections became *Naziriyat*. The sections below the *Naziriyah* became *Umudiyat*. Below that were lineages, often headed by a *Shaykh*, which had no formal position in the administrative hierarchy. The smallest unit, which the *baqqara* (a group of tribes descending from Darfor region of Sudan) called *Usrah* (means family), was likely to consist of a man, his sons, their sons, and any daughters who had not yet married. (Patrilineal cousins were preferred marriage partners.) The *Usrah* and the women who married into it constituted an extended family. All divisions had rights to all tribal territory for grazing purposes as long as they stayed clear of cultivated land; however, through frequent use, tribal sections acquired rights to specific areas for gardens. Members of an *Usrah*, for example, returned year after year to the same land, which they regarded as their home.

The constant subdividing of lineages gave fluidity to nomadic society. Tribal sections seceded, moved away, and joined with others for various reasons. The composition and size of even the smallest social units varied according to the season of the year and the natural environment. Individuals, families, and larger units usually moved in search of a more favorable social environment, but also because of quarrels, crowding, or personal attachments. The size and composition of various groups, and ultimately of the tribe itself, depended on the amount of grazing land available and on the policies and personalities of the leaders.

Traditionally, a man rich in cattle always had been sure to attract followers. The industry, thrift, and hardiness needed to build a large herd have been considered highly desirable qualities. At the same time, a rich man would be expected to be generous. If he lived up to that expectation, his fame would spread, and he would attract more followers. But wealth alone did not gain a nomad power beyond the level of a camp or several related camps. Ambition, ability to manipulate, hardheaded shrewdness, and attention to such matters as the marriage of his daughters to possible allies were also required. In the pre-condominium era, leaders of various sections of a tribe had prestige but relatively little authority, in part because those who did not like them could leave.

The colonial authorities stabilized the floating power positions in the traditional system. For purposes of taxation, justice, and public order, the new government needed representative authorities over identifiable groups. Locality could not serve as a basis in a nomadic society, so the government settled on the leaders of patrilineal descent groups and gave them a formal power they had previously lacked.

The administrative structure of the *Naziriyah* and *Umudiyah* ended shortly after the establishment of President Jaafar an Nimeiri's government in 1969, but the families of those who had held formal authority retained a good deal of local power. This authority or administrative structure was officially revived in 1986 by the coalition government of Sadiq al Mahdi. Of continuing importance in economic and domestic matters and often in organizing political factions were minimal lineages, each comprehending three (at best four) generations. The social status of these lineages depended on whether they stemmed from old settler families or from newer ones.

In villages composed of families or lineages of several tribes, marriage would likely take place within the tribe. A class structure existed within villages. Large holdings were apt to be in the hands of merchants or leaders of religious brotherhoods, whose connections were wider and who did not necessarily live in the villages near their land. Although no longer nomadic, the ordinary villager preferred not to cultivate the land himself, however. Before the abolition of slavery, slaves did much of the work. Even after emancipation some ex- slaves or descendants of slaves remained as servants of their former masters or their descendants. Some villagers hired West Africans to do their work. Ex-slaves and semi nomads or gypsies (*halabi*, usually smiths) living near the village were looked down on, and marriage with them by members of other classes was out of the question. A descendant of slaves could acquire education and respect, but villagers did not consider him a suitable partner for their daughters. Slave women had formerly been taken as concubines by villagers, but it was not clear that they were acceptable as wives.

Landholders in government-sponsored projects did not own the property but were tenants of the government. The tenants might be displaced Nubians, settled non-Arab nomads--as in Gaziera project--settled or nomadic Arabs, or West Africans. Many of these people used hired labor, either West Africans or nomads temporarily without livestock. In many instances, the original tenant remained a working farmer even if he used wage labor. In others, however, the original tenant might leave management in the hands of a kinsman and either live as a nomad or work and live in a city, a lifestyle typical of Nubians. Although all settled communities were linked to the government, the projects involved a much closer relation between officials and villagers, because officials managed the people as well as the enterprise. In effect, however, officials were outsiders, dominating the community but not part of it. They identified with the civil service rather than the community. West Africans working in Arab settled communities formed cohesive communities of their own initiative, and their relations with Arab tenants appeared to be restricted to their work agreements, even though both groups were Muslims. Cotton cultivation, practiced on most of the farms, was labor intensive, and because available labor was often scarce, particularly during the picking season, the West African laborers could command good wages. Their wages were set by agreements between the tenants who held the land and the headmen of the West African communities, and these agreements tended to set the wage scale for Arab laborers as well.

In the White Nile area, more recently settled by nomadic groups, aspects of nomadic social organization persisted through the condominium era. As among the nomads, leadership went to those who used their wealth generously and judiciously to gain the support of their lineages. In this case, however, wealth often took the form of grain rather than livestock. Most major lineages had such leaders, and those that did not were considered at a disadvantage. In addition to the wealthy, religious leaders (*Shaykh*) also had influence in these communities, particularly as mediators, in contrast to secular leaders who were often authoritarian. The establishment of the *Naziriyah* and *Umudiyah* system tended to fix leadership in particular families, but there were often conflicts over which members should hold office. In the case of the *Kawahla* tribes of the White Nile, the ruling family tended to settle these differences in order to maintain its monopoly of important positions, and it took on the characteristics of a ruling lineage. Other lineages, however, tended to decline in importance as the system of which they had been a part changed. The ruling lineage made a point of educating its sons, so that they could find positions in business or in government. Although the Nimeiri government abolished the older system of local government, it appears that the former ruling lineage continued to play a leading role in the area (5).

Sudanese extended families include uncles and cousins going back several generations. They determine a great deal about one's life, work and marriage opportunities. Traditionally the focus for Sudanese people has been the local village or nomadic community. These relatively small communities are made up of extended families based on lineage of male relatives and ancestors. The members of a lineage act in the group's interest, safeguarding territory or forming important ties with other families by marriage. Usually a family leader is a respected elder. Most Sudanese families hold strong traditional values in a rapidly changing world. Whether in rural or urban society, the woman's world has been domestic and the man's world, public. From everyday meals to formal socializing, such as a wedding feast, men and women are segregated. It is difficult to say how years of war; famine and migration have changed families in Sudan. Some rural Sudanese have recently moved to cities, where family and ethnic groups mix at school and work but still they do have strong continues relationship to where they came from.

2.4. Global situation of TB

TB is a disease caused by an organism called *Mycobacterium tuberculosis.* These organisms are also known as tubercle bacilli**.** Usually they affect the lungs, in which case the disease is called pulmonary TB. Pulmonary TB is the most common type of TB worldwide (6). In the year 1993, world health organization (WHO) declared TB as a global emergency. One third of the world's population is infected by the *Mycobacterium tuberculosis*.

In 2004, there were about 8.9 million new cases of TB disease (140/100 000 population) of which 3.9 million (62/100 000) were smear-positive; 741 000 were adults infected with the human immune deficiency virus (HIV). 1.7 million People (27/100 000) died from TB in 2004, including those co-infected with HIV (248 000). 95% of these estimated cases and 98% of deaths occur in developing countries. Of cases in developing countries, 75% are 15–50 years old (7). TB incidence was stable or falling in five out of 6 WHO regions, but growing at 0.6% per year globally, and the number of cases at 2.4% per year (8).

There were 2.1 million smear-positive cases notified by directly observed treatment short course (DOTS) programmes in 2004 which represent 53% of the estimated incidence. The increment in smear-positive cases notified under DOTS between 2003 and 2004 (350 000) was greater than ever before (the average annual increment from 1995–2000 was 134 000). If the observed acceleration in case-finding is maintained, DOTS programmes will detect more than 60% of all estimated cases in 2005, but they will fall short of the 70% target.

Treatment success (refer to section 2.5) in the 2003 DOTS cohort of 1.7 million patients was 82% on average, edging closer to the 85% target.

2.5. Definitions of TB

Case of TB a patient in whom TB has been confirmed by bacteriology or diagnosed by a clinician.

Definite case: A patient with positive culture for the *Mycobacterium TB* complex. In countries where culture is not routinely available, a patient with 2 sputum smears positive for acid fast bacilli (AFB+) is also considered a definite case.

Pulmonary case: A patient with TB disease involving the lung parenchyma.

Smear-positive pulmonary case: A patient with at least 2 initial sputum smear examinations (direct smear microscopy) AFB+; or one sputum examination AFB+ and radiographic abnormalities consistent with active pulmonary TB as determined by a clinician; or one sputum specimen AFB+ and culture positive for *M. TB*.

Smear-negative pulmonary case: A patient with pulmonary TB not meeting the above criteria for smear-positive disease.

Diagnostic criteria should include: at least 3 sputum smear examinations negative for AFB; and radiographic abnormalities consistent with active pulmonary TB; and no response to a course of broad-spectrum antibiotics; and decision by a clinician to treat with a full course of anti-TB therapy; or positive culture but negative AFB sputum examinations.

Extra-pulmonary case: A patient with TB of organs other than the lungs (e.g. pleura, lymph nodes, abdomen, genitourinary tract, skin, joints and bones, meninges). Diagnosis should be based on one culture-positive specimen, or histological or strong clinical evidence consistent with active extra-pulmonary disease, followed by a decision by a clinician to treat with a full course of anti-TB chemotherapy.

A patient in whom both pulmonary and extra-pulmonary TB has been diagnosed is classified as a pulmonary case.

New case: A patient who has never had treatment for TB or who has taken anti-TB drugs for less than 1 month.

Relapse case: A patient previously declared cured but with a new episode of bacteriologically positive (sputum smear or culture) TB.

Re-treatment case: A patient previously treated for TB, undergoing treatment for a new episode of bacteriologically-positive TB.

Cured: When an initially smear-positive patient who was smear-negative in the last month of treatment and on at least one previous occasion.

Treatment success rate: Equals the cure rate plus the complete rate.

Died: A patient who died from any cause during treatment.

Failed: A smear-positive patient who remained smear-positive at month 5 or later during treatment.

Defaulted: A patient whose treatment was interrupted for 2 consecutive months or more.

Transferred out: A patient who transferred to another reporting unit and whose treatment outcome is not known.

Successfully treated: A patient who was cured *and* who completed treatment (7).

Case detection rate: percentage of those new smear positive cases detected from the expected cases.

2.6. Bases of TB control

All the efforts and strategies to control TB are based on breaking transmission cycle through reduction of infectious cases by efficient case-finding supplemented by high cure rates (1) and reduction of the time of infectiousness of a case through early intervention with appropriate chemotherapy, and thus reduction of the potential that members of the community continue to be exposed (9). Despite it looks so simple but in fact the situation is completely different since health policies in many countries is lacking attention to TB, the HIV epidemic which influenced the global pandemic of TB, the appearance of multi drug resistant (MDR) strains that challenge treating TB, Change of the virulence of *M. TB* with the appearance of new strains which are more virulent and more resistant to treatment and finally delay in detection and treatment of TB cases.

2.7. Epidemiology of TB transmission

TB transmission depends upon exposure to tubercle bacilli. There are three major factors that determine the risk of becoming exposed; the number of incident infectious cases in the community, the more the number the much more is the risk to be exposed; the number and nature of interactions between a case and a susceptible contact per unit of time of infectiousness and the duration of the infectiousness.

Factors determine case-contact interactions include population density. In rural setting the population density is low when compared with an urban setting so the case contact interaction is much lesser. That is why we can expect lower level of infectiousness in rural population. Another factor is the family size and social arrangement within the family, which will affect the transmission among the family members. A pronounced factor is the climatic conditions. In cold climate people tend to stay in a closed places which will promote TB transmission, while in temperate areas people tend to keep their houses well ventilated. Finally age of the patient which will affect the patterns of social participation, people tend to socialize with their age group, which make transmission of TB occur among specific age groups (9).

2.8. TB epidemiology in Sudan

With a total population of 41,236,378 (2) and an Annual risk of infection (ARI) of 1.8 ,which means that among 100.000 population there is an estimated 180 new TB cases annually, 90 (50%) are new smear positive cases, Sudan shoulder 8% of TB burden in the East Mediterranean Region (10). TB accounts for 11.6% of hospital admissions in Sudan. TB is one of the most common causes of hospital deaths. The mortality from TB is around 41 per 100,000 populations / year (10). Efforts to control TB in Sudan started since 1940s by 2 TB sanatoria: Abu Anga & River Hospital. The WHO /IUATLD (International Union against TB and Lung Diseases) DOTS strategy was implemented since 1993 in a pilot project that triggered a nation-wide implementation since 1995. In the year 2003 Sudan announced 100% DOTS coverage when considering the availability of TB management facilities according to population. Despite this, case detection rate remains static between 27 % (1998) and 35% (2004) (Figure 2.4). Those figures constitute around 50% of WHO target for the year 2005. When looking at the success rate the spreading of the services to the periphery was accompanied with an increase in success rate (figure 2.5) till it reached 82% for the year 2003 (7). Still there are many challenges facing the national TB control programme that can be summarized as follow:

- Millennium Development Goals which focus on the WHO target of decreasing ARI by 50% by the year 2015
- MDR TB
- HIV/AIDS which fuels TB pandemic
- Ownership since TB control efforts still depends on outside funds
- Conflicts in a form of war and political instability that ruins the whole efforts at specific states of Sudan like Darfor states.

Figure2.4: shows case detection rate 1995-2004.

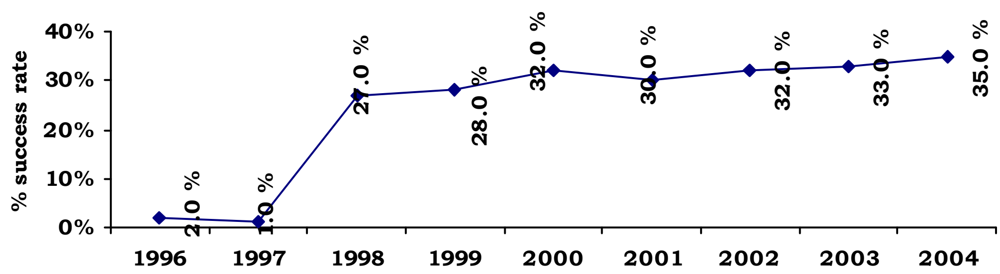
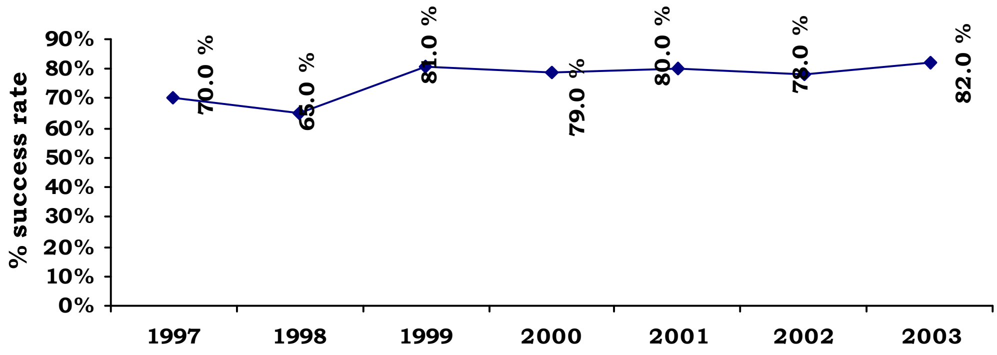


Figure 2.5: shows the progress in success rates 1997-2003



2.9. TB profile Gaziera State

Gaziera State is the 2nd largest state of Sudan with a total population of 3.5 (1991) million, of which 77.3% are rural population. Male to female ratio is 97.4/100 and population below 15 years represents 42.2% of the total population.

DOTS was implemented since 1996 with a total number of tuberculosis management units (TBMUs) of 36, 100% DOTS coverage was achieved in year 2002. The expansion phase was accompanied by increase in cases registered every year figure 6.6, and so was the detection rate (figure 2.6 and 2.7). Detection rate was 38% for the year 2004 and success rate was 82.3% for the year 2003 (11).

Figure2.6: shows the progress in case registration 1997-2004.

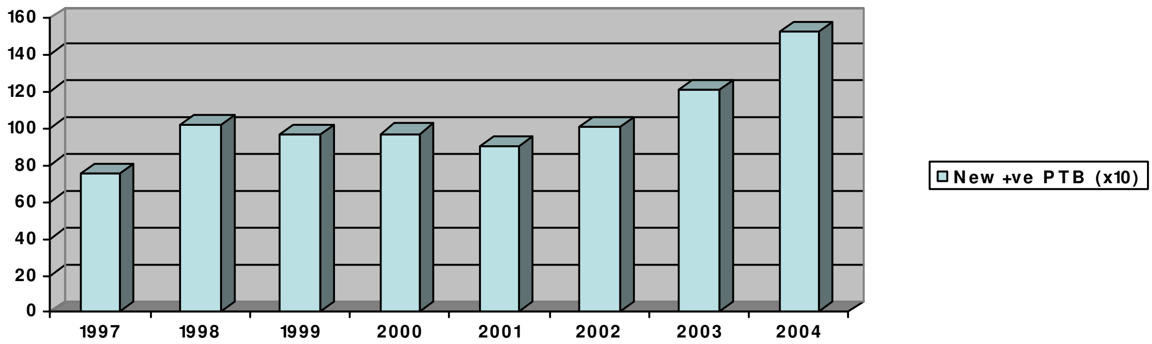
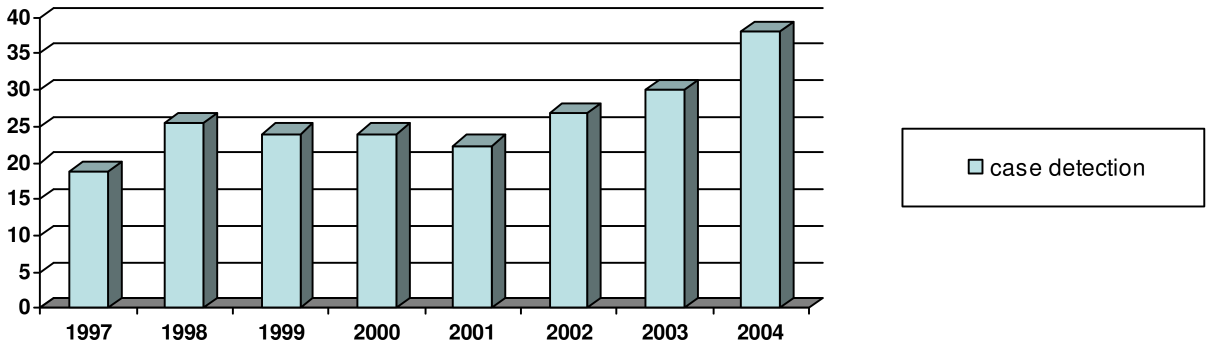
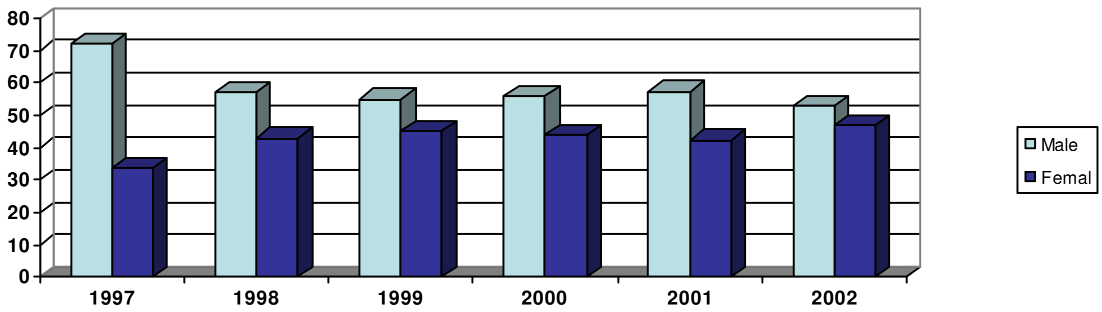


Figure 2.7: shows the progress in case detection rate 1997-2004.



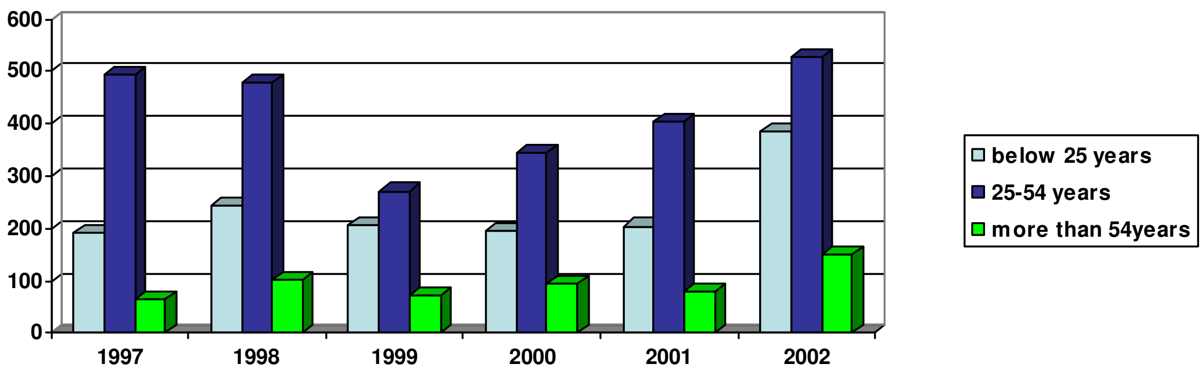
When considering gender variation in notification, we will find that females were less notified than males; although female's representation was improved from 33.8% during year 1997 to 47% for the year 2002 from the total notified cases (Figure 2.8).

Figure 2.8: trend in gender notification of new smear positive TB (1997-2002)



When looking at the age distribution of the notified cases of new smear positive TB we will find those who were between 25 and 54 years all represent the majority of cases notified (Figure 2.9).

Figure 2.9: age distribution among newly diagnosed smear positive TB (1997-2002)



2.10. Delay of TB diagnosis

Total diagnostic delay

Many studies were conducted to explore the reasons behind delay of TB diagnosis and commencement of treatment and almost all papers agreed on defining total delay as the period related to the patient and the health care provider before diagnosis and commencement of treatment. (12) Delay in diagnosis and treatment of TB is one of the challenges facing control efforts since two major outcomes occur:

- TB patient will have more severed disease with more complications and higher mortality (13,14,15). Without treatment 50% of patients will die within 5 years.
- The patient becomes a source of infection and on average will infect 10 to 15 peoples per year (1).

Total diagnostic delay was documented over all continents. The length of which varied with a range from 35 days in New York, USA (16), to 136 days in Mwanza region, Tanzania (17). In most of the studies reviewed it range between 60-90 days e.g. in Gambia 60 days (13), in Botswana 84 days (18), in Ethiopia 64 days (19), in India 60 days (20), in Malaysia 87 days (21), in Korea 60 days (22) and in Sudan 53 days (23).

Referring to figure 2.10, delay of diagnosis and treatment was sub-classified into: patient's delay and health system's delay (sometimes called health provider's delay). The last one was subdivided into non TB health facility's delay (also called other health provider's delay) and TB health provider's delay (also called TBMU's delay).

Figure 2.10: classification of total diagnostic delay.

Total diagnostic delay		
Patient's delay	**Health system's delay**	
	Other health provider's delay	**TBMU's delay**

Time →

Patient's delay

Many definitions were used in different studies. For example patient's delay was defined as the time interval from the appearance of the major pulmonary symptoms of the disease until the first visit to a medical facility (19, 24, 18, 20, 13). Another definition was the period from the onset of any TB or non-TB symptoms to the first visit to medical facility (16). The last definition is considered not to be valid since it is not in line with the WHO definition of a TB suspect.

Other challenge was what to be considered as patient's delay since some authors considered 30 days as a significant delay period; other chooses 42 days or 60 days. It was also studied as continues variable expressed as the median value from the study population. Finally others based on physician's experiences put a cut-off point.

In most of the studies patient's delay was the main contributor to the total delay (19,24,16,17,21,25,26,22,27).

The shortest delay was documented in Gambia (13), 0.3 weeks (2 days) and that was due to the definition used which was the total period between the onset of pulmonary symptoms of TB and first consultation even if the one consulted was a member of the family. The longest patient's delay was in Tanzania (17) 120 days. Most of the other studies ranged between 20 and 60 days (19,18,20,16,28,25,26,22,27,23,29).

Health system's delay

Health system delay was defined as the time interval from the first consultation until date of TB diagnosis (19). This definition is actually missing a very important component since just diagnosing TB is not the aim of the control activities. Many patients, even if they get diagnosed, suffer either from another long period before they start treatment or they receive no treatment at all. When looking at other definitions like the time interval from the first consultation till the start of treatment (18, 16, 13) or the duration in days between the first action taken by the patients and the date of sputum examination for diagnosis of TB (20), still an exact definition of consultation did not explain the role of health system in the total delay since some authors consider consultation even if the patient consulted a member of his family or a friend (13). According to my understanding this is a part of patient's delay because it stills a patient's health seeking behavior.

What is considered as health system's delay? Some studies considered 7 days, or more, between consultation and diagnosis or start of treatment as a delay. Other studies put the cut-off point as 10 days, 14 days, the median or a specific number of days proposed by physicians according to their experiences.

The shortest time between medical consultation and initiation of treatment was documented in two studies in Korea and USA with a mean period of 6 days (16, 22). The longest delay was documented in Gambian study 59 days (13). This variation was actually due to the different definitions used in different studies. But in most of studies the health provider's period was in a range of 20-40 days (18, 19, 25, 26, 27,23).

Only in 3 studies (13, 28,29) health system delay was considered the main contributor to the total delay. When looking at those studies we will find that they included part of patient's delay or patient related delay within the definition of health system delay. In the Gambian study (13) consultation is recorded even when traditional healer or family member was consulted. In an Ethiopian study (29) health provider was defined as any one who gave the patient something as medication but not a family member.

In another three studies there were no significant difference between patient's delay and health system's delay as the main contributor to the total delay period e.g. Sudan (23), Botswana (18) and India (20).

2.11. Contributing factors to the delay of TB diagnosis and treatment

Rural and urban settings

Despite not many studies were conducted comparing rural and urban populations, all studies available documented that rural TB patients suffer a longer diagnostic period than urban populations. For example in studies from Botswana (18), Ghana (28), Korea (22), Gambia (13) and Tanzania (17) the total delay were significantly longer in rural areas. In another two studies conducted in Ethiopia, the first was conducted in urban area (19), showed a mean patient delay of 78 days which was shorter than described from rural Ethiopia, 179 days (30).

Age of the patient

Total diagnostic period

It seems that total diagnostic period was associated with age. In Gambia, total diagnostic period was shorter in young TB patients (13) and in urban Lusaka, Zambia longer diagnostic period was associated with older age (31). London, UK, the delay appeared to be strongly associated with age over 33 years (26). In Korea (22), and Nepal (32), among women, the total diagnostic period did not differ by age.

Patient's period

In India, A longer patient's period was associated with age +45 years (20). In New York City, USA, age 55–64 years was associated with longer patient's period (16). But In Nigeria, patient's period was not found to be significantly associated with age (24).

Health system's period

In Australia, health system's period was significantly longer for those aged over 45 (25), Two US studies also showed the same but only for patients aged over 65 (14,33). In Ethiopia (19) and Australia (34), long health system's period was not associated with age.

Gender of the patient

Total diagnostic period was not found to be significantly associated with gender in most of the papers reviewed (13, 19, 26, 18, 31, 21, 22, 34, 24). An exception was in India, where men were more likely to delay seeking care (20). In Vietnam and Australia, health system's period was significantly longer for females (27, 25). While in Nepal and Ghana, women reported a longer total diagnostic period than men (28, 32).

Education, socioeconomic level and Knowledge about TB

Apart from two studies conducted in Tanzania and India where Knowledge about TB and literacy were found associated with prolonged diagnostic period, respectively (20,17). All other studies documented no significant association.

Distance from the TB diagnostic unit

Three studies, from India, Zambia and Ethiopia, founded association between distances more than 30 minutes walk and distance more than 2 km associated with delay of TB diagnosis (19, 20, 31). Other studies founded no significant association (22,32).

Presenting symptoms

Absence of cough or haemoptysis were associated with longer diagnostic period in USA and Ethiopia (19,16). While in Gambian study haemoptysis was associated with shorter time of delay (13). Other studies revealed no association (24, 22).

Private practitioner consultation

Studies from Australia, India and Zambia showed that delay was associated with prior attendance to private clinics (20, 34, 31).

3. Goal and objectives

3.1. Goal

The overall goal of this study was to determine the magnitude of both total delay and total period of TB diagnosis and initiation of anti TB treatment and to investigate the possible contributing factors so as to highlight the road for policies targeting early detection of TB in a rural setting in Sudan.

3.2. Objectives

3.2.1. General objectives

To determine the duration between the onset of a major TB symptom till the start of anti TB treatment for new cases of smear positive pulmonary TB presenting to the national TB control programme units in Gaziera State and to investigate possible contributing factors.

3.2.2. Specific objectives

1. To determine the total diagnostic period and both patient's and health system contributions to that period.
2. To investigate patient's possible contributing factors namely age, sex, socio economic status, knowledge about major TB symptoms and health seeking behaviors.
3. To investigate health system's possible contributing factors namely distance of the health service, financial barriers and the practice of other health providers and TBMU staff towards a TB suspect.

4. Methodology

The study design used was a quantitative observational cross-sectional study. A semi-structured questionnaire containing patient characteristics was applied to collect data. A combination of both descriptive and analytical approaches was used to meet the study objectives.

4.1. Study area

This study was conducted in Gaziera State which is one of the 26 States of Sudan. It is located in the middle of Sudan. On the northern side there is Khartoum State, White Nile State from the west, Gadarif State from the east and Sinnar State from the south. The total population of the State was 3.5 million (1991) of which 77.3% are rural population. The capital city is Wad Madani. Administratively the State is divided into 6 provinces, namely Gaziera, Managil, Butana, Kamleen, Hasahisa and Om el Gura.

The State was chosen for this study because:

- TB control is given a high priority by state government.
- Existence of a well functioning TB control programme represented by 100% coverage of TB control services and 82.3% success rate for the year 2003.
- With 38% detection rate for the year 2004, which seems low with 100% DOTS coverage, it was suitable for investigating accessibility barriers behind low detection rate.
- The state has a big rural population (77.3% of total population)
- Feasibility of study area for conducting the research was high compared to other states with domination of rural population.

4.2. Study Population

Definition of study population

All newly diagnosed patients with smear positive pulmonary TB in Gaziera State during the data collection period were eligible as study population.

Inclusion criteria

All new smear positive pulmonary TB 15 years or older and willing to participate in this study were included.

Exclusion criteria

- Other forms of TB.
- Less than 15 years old.
- Not willing to participate in this study.
- Those who were too ill to be interviewed.

4.3. Sampling

When the study sample is selected from a larger study population, statistical inference will be more rigorous if the selection process is random, or effectively random; that is to say, if each individual in the study population has a known (usually identical) non-zero probability of selection.

The study population is large and widely scattered through out the state but for the sake of convenience we concentrated this study in a few areas only. This was done by a multistage sampling. The risk in this technique is the loss of some statistical efficiency, especially if only a few units were selected at the first stage.

Sampling was done using a multistage random sampling technique:

- From the total of 6 provinces, 5 provinces were selected randomly through a lottery technique.
- Within those provinces there were 34 TBMUS, from which those with less than 30 newly diagnosed smear positive TB patients during the year 2003 were excluded.
- Then all eligible new smears positive pulmonary TB registered during data collection period in those 11 TBMUS were recruited.

Sample size and statistical power

All eligible cases from the study area were included in this study during the data collection period.

According to the assumption based on the case finding during the year 2003, we expected to find 347 cases during the 5 months of data collection. Data collection was extended for 6 months (from 18th of July 2005 till 9th of January 2006) and only 216 cases were recruited from the 11 TBMUs included in this study. The reason behind this was the low case registration during the first 4 months (123 cases only). The trend in TB notification in Sudan is a higher notification rate during the first and second quarters of the year followed by sloping down during the 3rd until it reaches the least during the fourth quarter. There was no explanation for this phenomenon except some theories. The most reasonable one was the one linking this to the rainy season in the country.

From this sample size (216), using a margin of allowable error of ±5%, a confidence interval of 95% and Student's formula $n = Z^2 * P (1-P)/E^2)$ where

n= 216

Z (confidence interval of 95%) = 1.96

P (prevalence) = the prevalence of delay more than 42 days

E (allowable error) = 0.05

We found that P= 83.09%, which means our sample size was suitable for analysis using the statistical power given above only if the prevalence of delay for more than 42 days was equal to or more than 83.09%. From our results the prevalence of diagnostic delay of more than 42 days was 87.5%.

4.4. Study design

For the purpose of this study a quantitative cross sectional method was used. The use of quantitative method provides factual, reliable data that are usually generalized to the larger population of study. The quantitative method will permit to determine the duration of all types of delays and to find out the type of correlation between the risk factors under investigation and delay of TB diagnosis and treatment

In our study we were looking for delay in TB diagnosis and what are the possible contributing factors to this. We divided this period into two major periods the cause of which was either the patient himself or the health providers practice. Then we looked for possible risk factors for both periods. For example we assessed how the TB patient's gender and how the gender difference affected the process of diagnosis.

By health providers practice we meant generally what people do according to what they knew. Health providers in this study were divided into non TB diagnostic facility and TB diagnostic facilities.

A cross sectional study measures the prevalence of health outcomes or determinants of health, or both, in a population at a point in time or over a short period. Such information can be used to explore risk factors and association. However, associations were interpreted with caution. Bias which may arise because of selection into or out of the study population was put in consideration. A cross sectional design may also make it difficult to establish what is cause and what is effect while Other applications of cross sectional surveys lie in planning health care, In this study recommendations were given to prevent delay in the diagnosis of TB to the national TB programme based on the prevalence of different risk factors studied.

In this study all the information were collected at the same time because the subjects were only contacted once. This helped to assess the situation at one specific time and helped in avoiding recall bias and loss of follow-up. The most limitation of the cross-sectional design was that we couldn't make a causality effect between cause and the outcome.

4.5. Data collection procedure

Epidemiological data are often obtained by means of questionnaires. These may be either self administered (that is, completed by the subject) or administered at interview. Self administered questionnaires are easier to standardize because the possibility of systematic differences in interviewing technique is avoided. On the other hand, they are limited by the need to be unambiguously understood by all subjects. An interviewer may be essential to collect information on complex topics. In this study we used administered interviews.

On questionnaire design attention was paid to the language used. It was clear and simple. With short questions covering one point. Since a question that has been used successfully in a previous study we could take advantage of repeating some of the questions which was used in Khartoum questionnaire. That was used two years ago by Dr. Mohammed Sid Ahmed (23). The order of questions took into account the sensitivities of the person to whom they were addressed and was designed to facilitate recall. For example, all questions relating to one phase of the person's life was grouped together. Since interviewers were used in this study, the wording with which they asked questions was standardized as far as possible. The questionnaire is in (Annex 2)

The questionnaire was divided into main parts:

1. Socio-demographic characteristics of the subject: that includes age, sex, and marital status, housing conditions, educational level, monthly income and distance from the TB health facility.
2. Information related to the subject current illness: his/her knowledge about symptoms of the current illness, duration, and action taken to manage his/her illness.

3. Non TB health provider's practice: this includes investigations requested, diagnosis given, and medication given to a suspected case, referral to TB facility and total period from the patient first consultation till referral to TB facility.
4. TB health providers: include investigations requested, period from presentation at TB facility till start of treatment and the role of the laboratory in that period.

Some questions were linked together in a way that they validated each other. The final four questions were filled in from the TB registers books.

11 medical assistances working at the TBMUs where data collection took place were recruited. Two days training on standardization of the words used for interview conduction was accomplished. Piloting of the questionnaire was done. A monthly supervisory visit to collect and review filled questionnaires was done.

4.6. Definition of variables

Dependant (Outcome) variable

1. Total period: The period in days related to the patient and the health care provider before diagnosis and commencement of treatment between the onset of a major TB symptom and the start of anti TB drugs.

Subset of dependent variable:

1. Patient's period: The time interval from the appearance of the major pulmonary symptoms of the TB until the first visit to a medical facility with a qualified medical provider.
2. Total Health system's period: the duration in days between the first visit of the patients to a medical facility with a qualified medical provider and the date of start of anti TB medications.
3. Other health provider's period: the duration in days between the first visits of the patient to a health facility with a qualified medical provider until the first visit to TBMU.
4. TBMU's period: the duration in days between the first days the patient visited the TBMU until the first day of the starting anti TB drugs.

5. Post referral period: the duration in days from patient referral by other health provider till the patient reach TBMU.

Independent (explanatory) variables

1. Qualified medical provider: medical provider who is legible for practicing medical care as a doctor or medical assistant and had the capability to suspect TB.
2. Age: age in years of participant at last birthday
3. Sex: physical sex of participant.
4. Marital status: in terms of legal status (married, single, divorced or widowed)
5. Socioeconomic status: based on participant education, occupation, approximate monthly income, residence, numbers of room in the house, number of family members and average number of persons/room in the house.
6. Distance from the TB facility: the distance in minutes walking between patient's house and TB diagnostic facility.
7. Knowledge about TB symptoms: relating cough as the first symptoms to the patient's current condition.
8. Patient's health seeking behaviors: in terms of self-medication usage, type of self-medications, type of health provider visited first and reasons for coming to the TBMU.
9. Other health provider related barriers: mode of payment to have a public health service, investigation performed and number of other health providers visited before the TBMU.
10. Sputum grading for AFB: the level of sputum grading for AFB that range from scanty to 3 +++ according to the TBMU laboratory register book.

4.7. Processing and Analysis of data

Processing of data

The answers to the questions were codified before entering them in the computer. This codification of the answers made the analysis of the data easier. The data entered were also checked for conformity before analysis. All the questionnaires were numbered before starting data collection.

For the interpretation of the results we used the data gathered from the study sample.

Analysis

Variables were defined and entered to Statistical Package for Social Sciences (SPSS) version 12 for Windows. Screening for errors was performed and caused removal of data for 6 cases since they contain obvious errors concerning the validity to be analyzed.

A preliminary analysis using descriptive statistics and graphs was performed. All scale scores were calculated. Some contentious variables were collapsed into groups and the numbers of other categorical variables were collapsed.

For the purpose of answering the study question two ways of analysis were performed for exploring the relationship between the dependent and independent variables. In the first one the dependant variables (total diagnostic period, patient's period and health system's period) were categorized into delayed period and non delayed period according to the definitions of the variables, then a binary logistic regression models were developed for each variable to explore the relationship between it and the independent variables in this study. In the second way of analysis parametric statistical tests to compare groups and nonparametric statistical tests were used to compare each of the dependant variables (total diagnostic period, patient's period, total health system's period, other health provider's period and TBMU's period) with the independent variables. The priorities for the type of test were for parametric tests since they are more sensitive. Before conducting any parametric test all assumption for the test were tested and if one assumption was not satisfied, nonparametric statistical tests were used. The only one exemption was normal distribution assumption and that was because the sample size was large.

The level of statistical significance used was $p<0.05$ at CI of 95%.

Results were presented using sentences, tables and graphs.

4.8 Ethical issues

This study was conducted according to the Helsinki Declaration and International Guidelines for Ethical Review of Epidemiological Studies (CIOMS) Geneva 1991.

The concept of voluntaries and informed consent was applied to the community as a whole represented by FMOH and to each individual member who was subject of research. Irrespective of the socio-economic status and educational levels, research subjects were counseled about the objectives of the study. The identity of records of human subjects of research was kept confidential and will not be disclosed without valid scientific and legal reasons. The interviews were always conducted by competent and qualified health personnel. The interviews were committed in a fair, honest, impartial and transparent manner and records and data will be maintained for a reasonable period. The research was conducted to benefit all human kind and not just socially better off. All institutional arrangements required to be made in respect of research were made in a transparent manner and records were properly maintained and preserved.

A written consent was signed, or finger printed, by the participants after accepting participation voluntarily. Based on this all participant had the right to enter the study or to refuse, to depart the study even after the consent was signed, to refuse answering any of the questionnaire questions. All new smear positive patients registered during the intake period in the selected centers were enrolled without gender differences. For the results of the study feed back will be forwarded to the NTP for further actions. Project protocol was subject to ethical clearance from Ethical Committee in Sudan FMOH and Ministry of Health in Gaziera State.
(Annex 3).

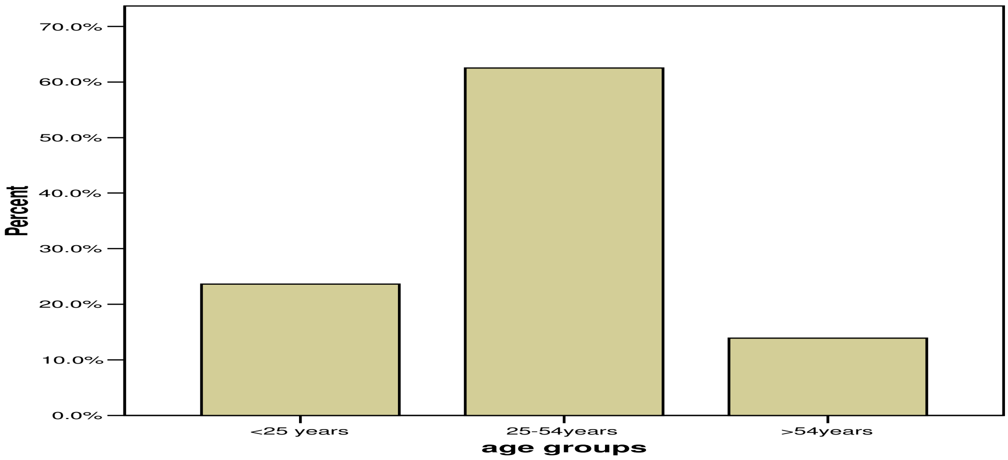
5. Results

5.1. Characteristics of the study sample

Age

The ages of study subjects ranged from 15 years to 76 years. The mean age was 36.43±14.94 years. Those who were less than 25 years old represented 23.6% of the total study group while those between 25 and 54 years old were 62.5% and more than 54 years were 13.9%.The Chi-Square goodness-of-fit test revealed a statistically significant difference between the groups $\{x^2(2) = 85.75, p<0.001\}$.

Figure 5.1: shows the age distribution of study subjects



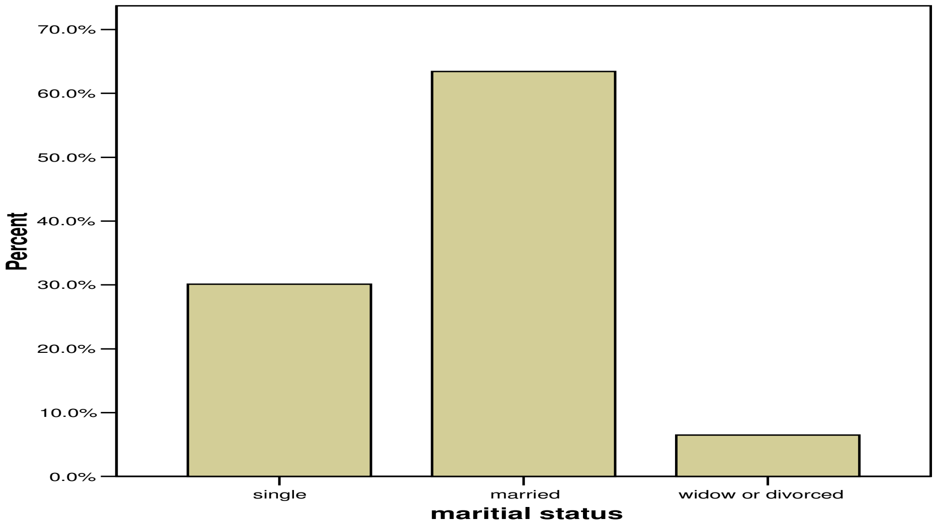
Sex

With a total number of 137, males were representing 63.4% of the total study subjects while females were (n=79) 36.6%. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the two group $\{x^2(1) = 15.75, p<0.001\}$.

Marital status

The majority of the study subjects was married (n=137) 63.4%, while singles represented (n=65) 30.1% and divorced and widows were (n=14) 6.5%. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the groups $\{x^2(2) = 106.083, p<0.001\}$.

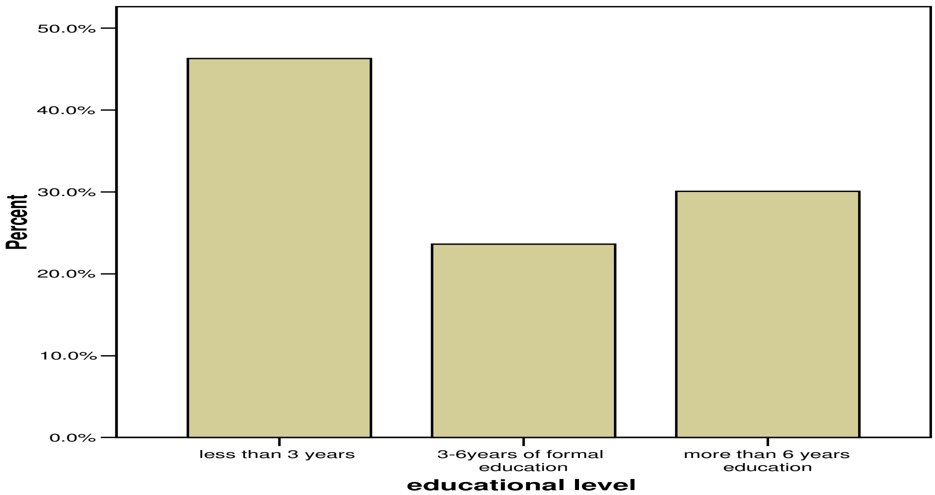
Figure 5.2: shows the different marital status of the study subjects.



Educational level

The educational levels for the study subjects were categorized into three groups according to the number of formal years of education. Those with less than 3 years of education were (n=100) 46.3%, those with 3 to 6 years of education were (n=51) 23.6% and those with education for more than 6 years were (n=65) 30.1%. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the groups {$x^2(2) = 17.694$, $p<0.001$}.

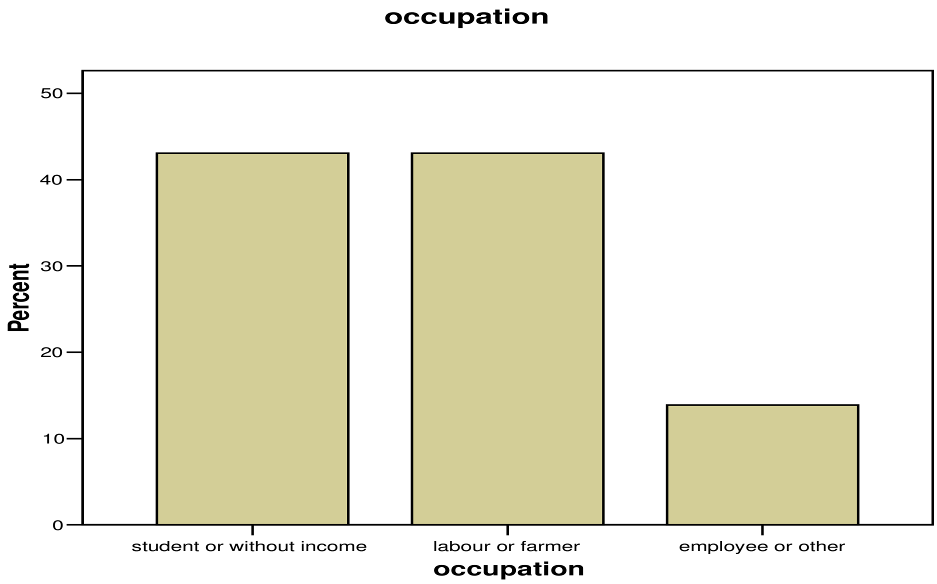
Figure 5.3: shows the different levels of education of study subjects.



Occupation

Students and those without income generating activities like housewives were (n=93) 43.1%, farmers and laborers were (n=93) 43.1% and those who were working as governmental employees and merchants were (n=30) 13.9%. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the groups {$x^2(2)$ =36.75, $p<0.001$}.

Figure 5.4: shows the different occupational categories of study subjects.



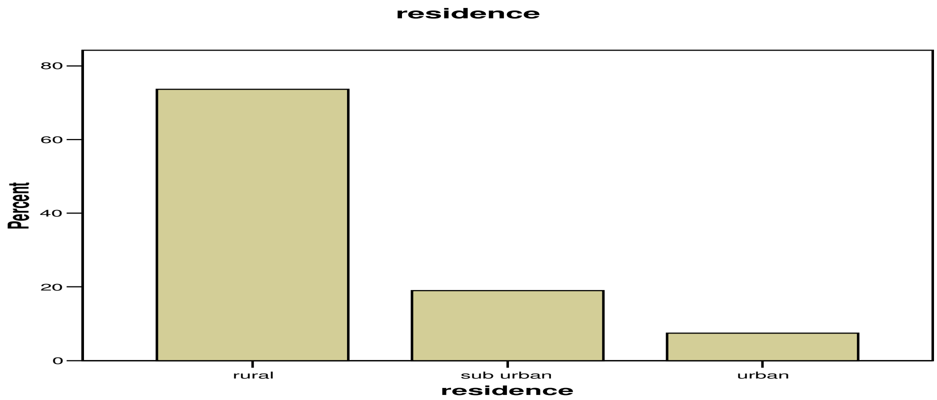
Monthly income

The majority of the study subjects had a monthly income less than 100 US$ (n=142) 65.7%. Those who reported monthly income more than 100 US$ were (n=74) 34.3%. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the tow groups {$x^2(1)$ =21.407, $p<0.001$}.

Residence

Since the setting of this study was a rural area so the majority of the study subjects, (n=159) 73.6%, were residing in a rural residence, while (n=41) 19% lived in a sub urban area and (n=16) 7.4% had an urban residence. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the groups {$x^2(2)$ =102.028, $p<0.001$}.

Figure 5.5: shows the distribution of study subjects among different residences under study.

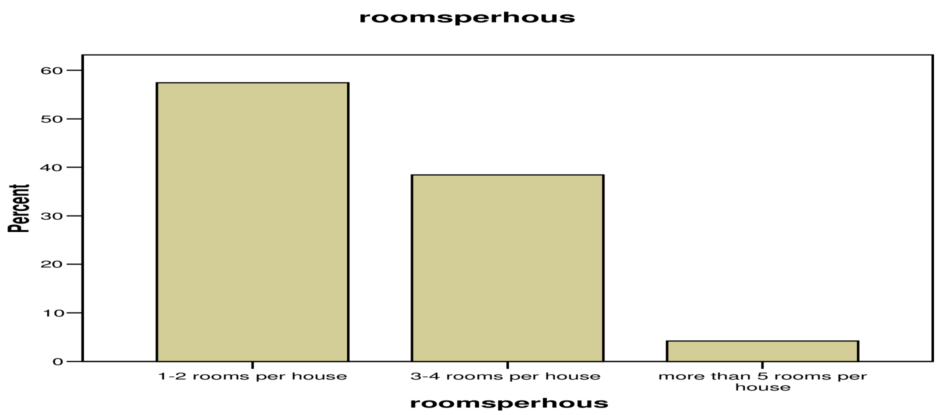


Housing conditions

Number of rooms per house

57.4% (124) of study subjects were living in houses with one to two rooms, 38.4% (n=83) were living in houses with three to four rooms and the rest (n=9) 4.2% were living in houses with more than 5 rooms. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the groups {$x^2(2)$ =94.361, p<0.001}.

Figure 5.6: shows housing conditions in term of number of rooms per house.



Number of persons per house

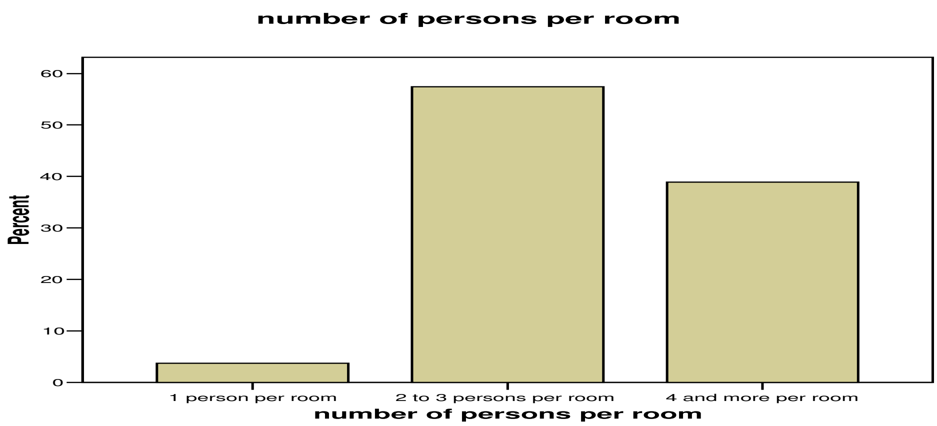
Most of the study subject's houses were shared by 7 to 9 persons (n=75) 34.7%, then from 4 to 6 persons (n=61) 28.2%, more than 9 persons per the house (n=48) 22.2% and those who lived in houses with two or three other people were (n=32) 14.8% of the total study subjects. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the groups {$x^2(2) = 18.704$, $p<0.001$}.

Figure 5.7: shows the housing condition in term of number of persons per house.

Number of persons per room

The majority of the study subjects were living in houses where 2 to 3 people share the same room (n=124) 57.4%. Only (n=8) 3.7% of the study subjects were from houses where there were only one per each room, while the rest of the study subjects (n=84) 38.9% shared the room with four or more people. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the groups {$x^2(2) = 96.444$, $p<0.001$}.

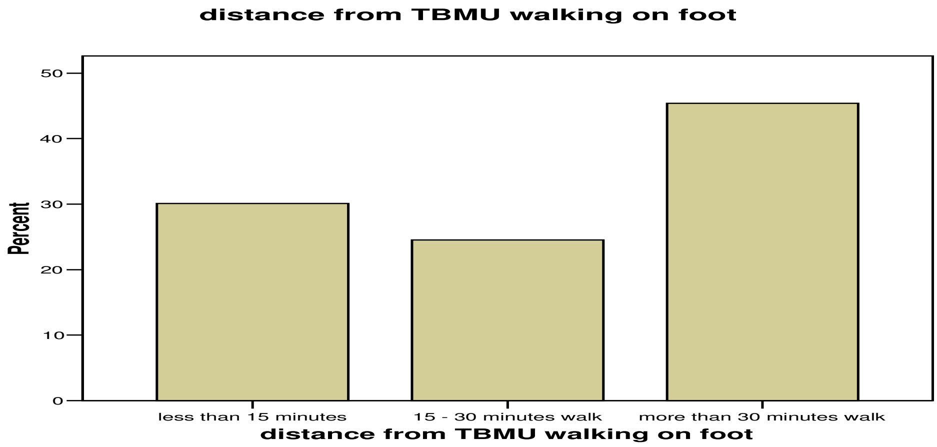
Figure 5.8: shows housing conditions in term of average persons per room in the house.



Distance from patient's residence to the TBMU

Despite the decentralization of health services in the state still (n=98) 45.4% of the study subjects claimed that the distance between their living and the TBMU was more than 30 minutes walking, while (n=53) 24.5% mentioned a distance of 15 to 30 minutes walking and only (n=65) 30.1% mentioned less than 15 minutes walking. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the groups $\{x^2(2) = 15.083, p<0.001\}$.

Figure 5.9: shows the distance between the TBMU and patient's houses.



First symptom related to TB

Most of the study subjects referred to cough as the first symptom related to their current illness (n=186) 86.1% while the rest (n=30) 13.9% referred to other symptoms like fever, tiredness, etc. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the two groups $\{x^2(1) = 112.667, p<0.001\}$.

Self-medication usage

144 (66.7%) of the study subjects mentioned that they did not try self-medication before consulting a health provider, while 72 (33.3%) tried self-medication before visiting a medical providers. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the two groups $\{x^2(1) = 24.0, p<0.001\}$.

Type of self-medication used

From those who tried self-medication before visiting a health provider 25 (34.7%) used traditional medication while the rest 47 (65.3%) used modern medications i.e. drugs. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the two groups {$x^2(1) = 6.722$, $p=0.01$}.

Type of first health provider visited

The majority of the study subjects 190 (88%) had firstly consulted a public health provider, while only 26 (12%) consulted a private health provider first. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the two groups {$x^2(1) = 124.519$, $p<0.001$}.

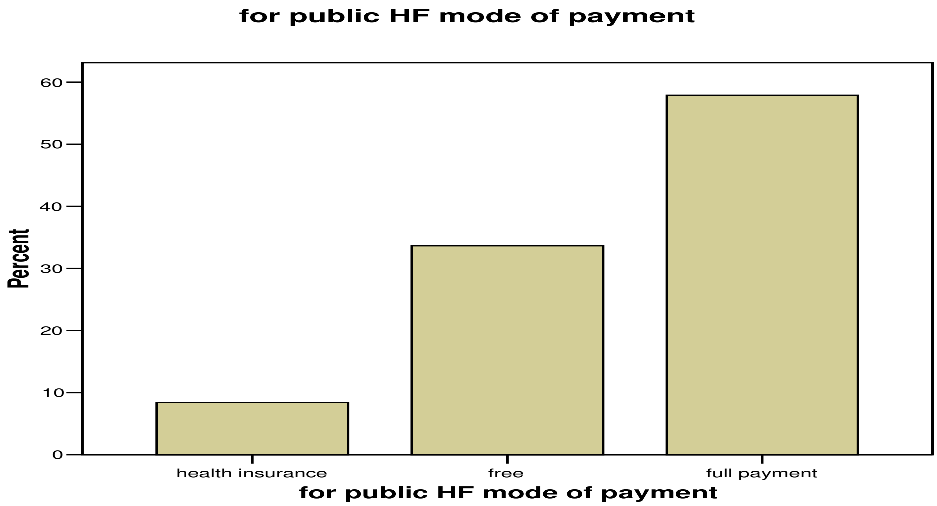
Type of investigation firstly performed before visiting the TBMU

From those who firstly consulted other health providers, 170 (89.5%) had some investigations performed. for 69 (40.6%) X-ray was performed, while 101 (59.4%) some sort of blood investigation was done for them. The Chi-Square goodness-of-fit test revealed that significantly of more patients had blood test {$x^2(1) = 6.024$, $p=0.014$}.

Mode of payment to the public health provider

Most of the study subjects 57.9% (n=110) paid a full fee for a public health provider, 33.7% (n=64) were for free and only 8.4% (n=16) were covered by a health insurance system. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the groups {$x^2(2) = 69.768$, $p<0.001$}.

Figure 5.10: shows the different types of mode of payment to public health facility.



Other health providers' consultation

92.1% (n=199) of the study subjects had consulted at least one other health providers before coming to the TBMU while only 7.9% (n=17) came directly to the TBMU. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the two groups {$x^2(1) = 153.352$, $p<0.001$}.

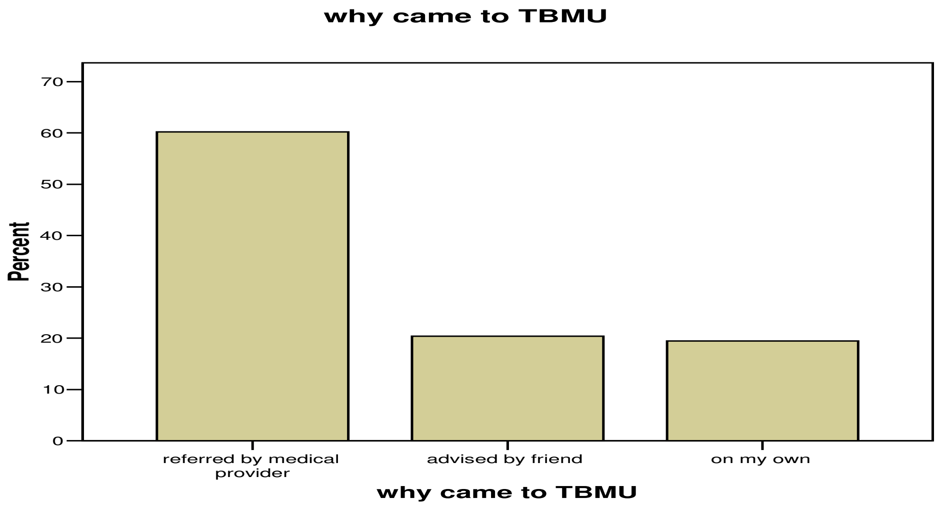
From those who visited other health providers 75.9% (151) visited one or two providers, while 16.1%(32) visited between three to four providers and the rest 8% (18) visited more than 4 health providers before the TBMU.

Females tended to visit a higher number of health providers (Mean Rank=128.43) than males (Mean Rank= 97.01) and this difference was statistically significant when analyzed using Mann-Whitney U test ($Z=-3.797$, $p<0.001$).

The reason given by the patient for coming to the TBMU

On searching for the reasons why the study subjects came to the TBMU, 130 (60.2%) were referred by health providers, 44 (20.4%) advised by a friend or a relative and 42 (19.4 %) came by their own initiative. The Chi-Square goodness-of-fit test revealed a statistically significant difference between the groups {$x^2(2) = 70.111$, $p<0.001$}.

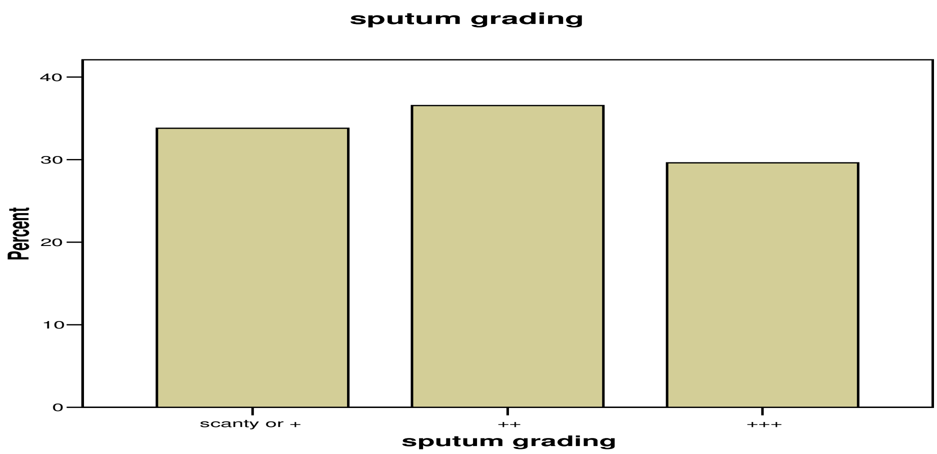
Figure 5.11: shows the reason behind coming to the TBMU.



Sputum grading for AFB

From the laboratory register book for TB, the sputum grading for AFB for all the patients in this study was identified. 33.8% (73) of the results were scanty to 1 +, 36.6% (79) were 2 ++ and 29.6% (64) were 3 +++. The Chi-Square goodness-of-fit test revealed none statistically significant difference between the groups {$x^2(2)$ =1.583, p=0.453}.

Figure 5.12: shows the different sputum grading for AFB of the study subjects.



5.2. Total period

Exploration

The shortest total diagnostic period was 19 days and the longest diagnostic period was 138 days. The mean total diagnostic period was 69.66 days (CI 65.88-73.43, SD± 28.143) while the median was 64.5 days. From the Skewness value (0.547) most of the values were clustered to the left at the low values while with (-0.248) Kurtosis distribution of the cases seemed to be a little bit flat with more cases clustering on both extremes.

Correlation between total period, health system's period and patient's period (Annex 4)

The relationship between total diagnostic period and patient's period was investigated using Pearson's product-moment correlation coefficient. Preliminary analysis was performed to ensure no violation of the assumption of linearity and homoscedasticity. A medium size, positive correlation between the two variables was found which was statistically significant {$r=0.347$, $n=216$, $p<0.001$}.

The relationship between total diagnostic period and total health system's period was investigated using Pearson's product-moment correlation coefficient. Preliminary analysis was performed to ensure no violation of the assumption of linearity and homoscedasticity. A small size positive correlation between the two variables was found, which was significant{$r=0.261$, $n=216$, $p<0.001$}.

The difference between the patient's period and total health system's period correlation coefficient was not statistically significant (Zobs= 0.88).

Analysis of the Total diagnostic period (based on cut-off point for long and short periods)

87.5% (189) of the study subjects showed a total diagnostic period of more than 42 days (considered as delayed) while 12.5% (27) showed a total diagnostic period of less than or equal to 42 days (considered as not delayed).

On investigating the factors that predict the likelihood that a patient would report a total diagnostic period of more than 42 days, analysis using binary logistic regression was performed. To guarantee fitness of the model, Omnibus test {$n= 190$, $x^2(19) =65.87$, $p<0.001$) and Homer and Lemeshow test {$x^2(8) =10.755$, $p=0.216$} were performed. The amount of variation in dependant variable explained by the model, according to Cox and Snell R^2 (0.293) and Nagelkerke R^2 (0.542), was 29.3 – 54.2%.

The model was 91.1% able to predict the correct category of each case according to the dependent variable i.e. total diagnostic period (0=period ≤42 days, 1=period > 42 days). The sensitivity of the model was 97.6% and the specificity was 48%. The positive predictive value for the model was 92.53% and the negative predictive value was 75%.

From the result of the model, one of the significant predictor variables was the number of health providers visited before the TBMU {Wald (df1) = 9.852, p=0.002, OR=7.663, CI= 2.149-27.327} which means the more the number of health providers visited before TBMU the more likely it is to have a total diagnostic period of more than 42 days. Other significant variable was residence of the patient {Wald (df1) = 8.102, p=0.004, OR=0.011, CI= 0.001-0.247} that indicated being a non rural residence was a predictor for total diagnostic delay, but the OR was very small. The sputum grading for AFB was found to be significant {Wald (df2) = 9.834, p=0.007} which indicated that having sputum results of scanty or 1 + is a predictor of having a delayed diagnostic period when compared to those with results like two crosses or 3 +++. But again the OR (0.061) indicated a small prediction. The marital status of the patient on the other hand was a significant predictor for having a delayed diagnostic period {Wald (df1) = 6.919, p=0.009, OR=0.02, CI= 0.001-0.367} which indicated that being divorced or widow is a predictor for having diagnostic period for more than 42 days when compared to singles and married, but still the effect is small.

Despite the monthly income was not significant as a predictor {Wald (df1) = 3.685, p=0.055} the OR=6.799 (CI= 0.96-48.125) there was a trend that having monthly income of more than 100 US$ could be a predictor of a total diagnostic period more than 42 days. Other variables like sex, occupation, educational level and the distance to the TBMU were not found to be predictors for total diagnostic period of more than 42 days.

Analysis of the Total diagnostic period (based on group's comparison)

Age of the patients

The relationship between total diagnostic period as measured by days and age of the patients as measured by years was investigated using Spearman's rank order correlation since the assumption didn't satisfy the requirements for using Pearson correlation. There was a very weak negative correlation between the two variables which was not significant {rho=-0.03, n=216, p=0.657).

A one way between groups analysis of variance was conducted to explore the impact of patient's age group on the total diagnostic period as measured in days. Subjects were divided into three groups according their age (group 1: who were less than 25 years old; group 2: were those between 25 and 54 years old and group 3: were those who were older than 54 years). Despite group 3 (M=61.13, SD=30.08, n=30) showed a shorter mean time when compared to both group 1 (M=67.67, SD=26.171, n=51) and group 2 (M=72.30, SD=28.189, n=135) these difference were not statistically significant {F (2, 213) = 2.122, p= 0.122}.

Gender

An independent-samples t-test was conducted to compare the total diagnostic period for the gender of the patient i.e. males and females. Despite the mean period for the females (M=72.66, SD=28.9, n=79) was longer than that for males (M=67.93, SD=27.65, n=137) the difference was not statistically significant {t(214) = -1.191, p=0.235} and the magnitude of the difference in the means was very small (eta squared =0.006)

Martial status

A one way between groups analysis of variance was conducted to explore the impact of martial status of the patients on the total diagnostic period as measured in days. Subjects were divided into three groups according to their martial status (group 1: single; group 2: between married and group 3: divorced or widows). There was statistically significant difference between the three groups p<0.05 {F (2, 213) = 7.599, p= 0.001}. The effect size, calculated using eta squared, was 0.066 which indicate that the difference between groups had a medium effect.

Post-hoc comparisons using Tukey HSD test indicated that the mean score for group 3 (mean 95.14, SD=36.469, n=14) was significantly different from both group 1 (M=72.0, SD=30.853, n=65, p=0.012) and group 2 (M=65.94, SD=24.365, n=137, p=0.001). There was no significant difference observed between the other two groups.

Educational level

A one way between groups analysis of variance was conducted to explore the impact of patient's level of education as measured by number of years of formal education on the total diagnostic period as measured in days. Subjects were divided into three groups according to how many years of schooling they had (group 1: less than 3 years of formal education; group 2: between 3 and 6 years of formal education and group 3: with more than 6 years of education). Those of group 2 (M=73.94, SD=27.749, n=51) seemed to have a longer mean period when compared to both group 1 (M=68.98, SD=29.408, n=100) and group 3 (M=67.34, SD=26.469, n=65). But there was no statistically significant difference between the three groups $p>0.05$ {$F (2, 213) = 0.839$, $p= 0.433$}.

Occupation

A one way between groups analysis of variance was conducted to explore the impact of patient's current occupation on the total diagnostic period as measured in days. Subjects were divided into three groups according the type of occupation they had (group 1: students or people without income generating activity; group 2: farmers or laborers and group 3: governmental employees or others). Group 2 (M=67.55, SD=27.526, n=93) had a shorter mean period than both group 1 (M=71.35, SD=27.201, n=93) and group 3 (M=70.93, SD=33.105, n=30) but there was no statistically significant difference between the three groups {$F (2, 213) = 0.459$, $p= 0.633$}.

Monthly income

An independent-samples t-test was conducted to compare the total diagnostic period for those with monthly income less than 100 US$ and those with monthly income more than 100 US$. Those with a monthly income more than 100 US$ (M=77.78, SD=27.835, n=74) had a longer mean time than those with less monthly income (M=65.42, SD=27.457, n=142). This difference was statistically significant {$t (214) = -3.125$, $p=0.002$}. The magnitude of the difference in the means suggested a small effect (eta squared =0.044).

Residence

A one way between groups analysis of variance was conducted to explore the impact of patient's residence on the total diagnostic period as measured in days.

Subjects were divided into three groups according their residences (group 1: rural residence; group 2: semi urban and group 3: urban). Group 3 (M=72.13, SD=39.746, n=16) tended to have a longer mean total diagnostic period when compared to both group 1 (M=69.38, SD=27.577, n=159) and group 2 (M=69.76, SD=25.657, n=41), but there was no statistically significant difference between the three groups {F (2, 213) = 0.069, p= 0.934}.

Housing conditions

Number of rooms per patient's house

The relationship between total diagnostic period as measured by days and housing condition of the patients as measured by number of rooms in the house was investigated using Spearman's rank order correlation since the assumption of linearity did not satisfy the requirement to use Pearson correlation. There was a small negative correlation between the two variables which was not significant {rho=-0.115, n=216, p=0.091).

Number of persons sharing the same house with the patient

The relationship between total diagnostic period as measured by days and housing condition of the patients as measured by number of persons in the house was investigated using Spearman's rank order correlation since the assumption of linearity did not satisfy the requirement to use Pearson correlation. There was a small negative correlation between the two variables which was not significant {rho=-0.09, n=216, p=0.186).

Average number of persons per room per in patient's house

A one way between groups analysis of variance was conducted to explore the impact of housing conditions of the patients as measured by number of persons per room in the patient's house on the total diagnostic period as measured in days. Subjects were divided into three groups according to the number of persons per room (group 1: one person per room; group 2: two to three persons per room and group 3: were those with more than three persons per room). Despite the difference in means showed a longer period for group 3 (M=72.9, SD=28.099, n=84) than both group 1 (M=67.63, SD=37.424, n=8) and group 2 (M=67.59, SD=27.571, n=124). There was no significant difference between the groups, {F (2, 213) = 0.914, p= 0.402}.

Distance to TBMU

A one way between groups analysis of variance was conducted to explore the impact of distance walking from the patient's house to the TBMU as measured by minutes walking on the total diagnostic period as measured in days. Subjects were divided into three groups according to the distance walking on feet between their houses and the TBMU (group 1: less than 15 minutes walk; group 2: between 15 and 30 minutes walk and group 3: more than 30 minutes walk). Group 1 ($M=71.35$, $SD=30.71$, $n=65$) showed a longer mean period when compared to both group 2 ($M=69.57$, $SD=27.703$, $n=53$) and group 3 ($M=68.58$, $SD=26.811$, $n=98$) but there was no statistically significant difference between the three groups $p>0.05$ {$F(2, 213) = 0.189$, $p= 0.828$}.

Table 5.1: shows the relationship between socio demographic variables and total diagnostic period:

Variable	n	Mean ± SD	F value	p value
Age				
< 25 years	51	67.67 ± 26.17		
25 – 54 years	135	72.30 ± 28.19	2.122	0.122
> 54 years	30	61.13 ± 30.08		
Sex				
Male	137	67.93 ± 27.05		
Female	79	72.06 ± 28.9	1.19	0.235
M. status				
Single	65	72.00 ± 30.85		
Married	137	65.94 ± 24.37	7.599	0.001
Divorced or widow	14	95.14 ± 36.47		
Education				
< 3 years	100	68.98 ± 29.41		
3-6 years	51	73.94 ± 27.75	0.839	0.433
> 6 years	65	67.34 ± 26.47		
Occupation				
Student or idle	93	71.35 ± 27.2		
Laborer or farmer	93	67.55 ± 27.53	0.459	0.633
Employee and others	30	70.93 ± 33.11		
Monthly income				
<100 US$	142	65.42 ± 27.46		
> 100 US$	74	77.78 ± 27.84	3.125	0.002
No. person/room				
1	8	67.63 ± 37.42		
2-3	124	67.59 ± 27.57	0.914	0.402
≥4	84	72.90 ± 28.1		
Residence				
Rural	159	69.38 ± 27.58		
Sub urban	41	69.76 ± 25.66	0.069	0.934
Urban	16	72.13 ± 39.75		
Distance to TBMU				
<15 minutes	65	71.35 ± 30.71		
15-30 minutes	53	69.75 ± 27.7	0.189	0.828
> 30 minutes	98	68.58 ± 26.81		

First symptom related to the current disease

An independent-samples t-test was conducted to compare the total diagnostic period for those who mentioned cough as a first symptom related to their current disease and those who related other symptoms rather than cough. There was no significant difference in scores for those who reported cough {M=70.72, SD= 28.634, n=186) than those who reported other symptoms (M=63.1, SD=24.29, n=30); t (214) = 1.378, p=0.17, the magnitude of the difference in the means was very small (eta squared =0.009).

Self-medication

An independent-samples t-test was conducted to compare the total diagnostic period for those who tried self-medication first with those who didn't try. There was no significant difference in scores for those who tried self-medication first {M=70.79, SD= 30.27) than those who didn't (M=69.09, SD=27.11, n=144); t (214) = 0.418, p=0.676} the magnitude of the difference in the means was very small (eta squared =0.0008).

Type of self-medication used

An independent-samples t-test was conducted to compare the total diagnostic period for those who used traditional medication and those used modern medication. There was significant difference in scores between those who used traditional medication first {M=86.04, SD= 27.929) and those who used modern medication (M=64.68, SD=28.525); t (70) = 3.332, p=0.001} the magnitude of the difference in the means had a medium effect (eta squared =0.06).

First medical provider visited

An independent-samples t-test was conducted to compare the total diagnostic period for those patient's who firstly consulted private clinic with those who firstly consulted a public unit. There was no significant difference in scores between those who firstly consulted private clinic {M=70.46, SD= 31.381) and those who consulted public unit (M=69.55, SD=27.761, n=190); t (214) = 0.155, p=0.877} the magnitude of the difference in the means was very small (eta squared =0.001).

Type of investigation performed before the TBMU

An independent-samples t-test was conducted to compare the total diagnostic period for those patient's who had X-Ray investigation and those who had blood investigations. There was no significant difference in scores between those who received an X-ray investigation {M=69.9, SD= 30.328) and those who had blood investigations (M=73.9, SD=27.552); t (168) = 0.893, p=0.373}.

Mode of payment to public health providers

A one way between groups analysis of variance was conducted to explore the impact of mode of payment to public health providers on the total diagnostic period as measured in days. Subjects were divided into three groups according to the mode of payment (group 1: through health insurance; group 2: for free and group 3: they have to pay the whole fee). There was statistically significant difference between the three groups p<0.05 {F (2, 187) = 4.918, p= 0.008}. The effect size, calculated using eta squared, was 0.05 which indicate that the difference between groups had small effect.

Post-hoc comparisons using Tukey HSD test indicated that the mean score for group 3 (mean 74.55, SD=27.733) was significantly longer than both group 1 (M=56.63, SD=27.011, n=16, p=0.039) and group 2 (M=64.17, SD=26.306, n=64, p=0.042). There was no significant difference observed between the other two groups.

Number of health providers visited before TBMU

The relationship between total diagnostic period as measured by days and number of health providers visited before TBMU as measured by number of health providers visited was investigated using Pearson product-moment correlation. Preliminary analysis was performed to ensure no violation of the assumption of normality, linearity and homoscedasticity. There was a small positive correlation between the two variables {r= 0.285, n=216, p<0.001}, with long diagnostic periods associated with higher number of medical providers being visited before the TBMU.

A one way between groups analysis of variance was conducted to explore the impact of number of health providers visited before reaching TBMU on the total diagnostic period as measured in days. Subjects were divided into three groups according to the number of health providers visited before TBMU (group 1: 1 or less health provider; group 2: 2 to 4 health providers and group 3: 5 or more health providers). There was statistically significant difference between the three groups {F (2, 213) = 4.245, p= 0.016}. The effect size, calculated using eta squared, was 0.04 which indicate that the difference between groups had small effect.

Post-hoc comparisons using Tukey HSD test indicated that the mean score for group 1 (n= 119, mean 65.11, SD=26.51) was significantly longer than group 3 (n= 16, M=82.63, SD=19.127, p=0.049). For group 2 (M=73.78, SD=30.689, n=81) there was no significant difference.

The reason given by the patient for coming to the TBMU

A one way between groups analysis of variance was conducted to explore the impact of the reason behind the patients coming to the TBMU on the total diagnostic period as measured in days. Subjects were divided into three groups according to the reasons why they came to the TBMU (group 1: were referred by a medical provider; group 2: were advised by a friend or a relative and group 3: came on their own initiative initiative). Those who came on their own initiative i.e. group 3 (M=68.19, SD=32.051, n=42) had a shorter mean period when compared to both group 1 (M=69.98, SD=26.447, n=130) and group 2 (M=70.11, SD=29.663, n=44), but there was no statistically significant difference between the three groups p>0.05 {F (2, 213) = 0.071, p= 0.932}.

Sputum grading

A one way between groups analysis of variance was conducted to explore whether sputum grade could indicate the length of the total diagnostic period. Subjects were divided into three groups according their sputum grading on diagnosis (group 1: were those with scanty to 1 + grading; group 2: were those with sputum grading of 2 ++ and group 3: were those with grade 3 +++ of sputum on diagnosis). Group 1 (M=74.07, SD=26.534, n=73) were having a longer mean period when compared to both group 2 (M=65.78, SD=27.87, n=79) and group 3 (M=69.41, SD=29.923, n=64) but There was no statistically significant difference between the three groups p>0.05 {F (2, 213) = 1.657, p= 0.193}.

Table 5.2: shows the relationship between current illness variables and total diagnostic period:

	n	Mean ± SD	F value	p value
1st symptom related current illness				
Cough	186	70.72 ± 28.63		
Other	30	63.10 ± 24.29	1.378	0.17
Self-medication use				
Yes	72	70.79 ± 30.27		
No	144	69.09 ± 27.11	0.418	0.676
Type of self-medication				
Traditional	25	86.04 ± 27.93		
Medical	47	64.68 ± 28.53	3.332	<0.001
Type of 1st HP visited				
Public	190	69.55 ± 27.76		
Private	26	70.46 ± 31.38	0.155	0.877
Type of investigation performed				
X ray	69	69.90 ± 30.33		
Others	101	73.90 ± 27.55	0.893	0.373
Mode of payment to PH* facility				
Free	64	64.17 ± 26.31		
Health insurance	16	56.63 ± 27.01	4.918	0.008
Full payment	110	74.55 ± 27.73		
No. of HP visited before TBMU**				
1 or none	119	65.11 ± 26.51		
2-4	81	73.78 ± 30.69	4.245	0.049
5 or more	16	82.63 ± 19.13		
Reason behind coming to TBMU				
Referred by other HP**	130	69.98 ± 26.45		
Advised by friend	44	70.11 ± 29.66	0.071	0.932
On own initiative	42	68.19 ± 32.05		
Sputum grading				
Scanty / 1 +	73	74.07 ± 26.54		
2 ++	79	65.78 ± 27.87	1.657	0.193
3 +++	64	69.41 ± 29.94		

* Public Health, ** Health Provider

5.3. Patient's period

Exploration

The shortest patient's period was 2 days and the longest was 120 days. The mean patient's period was 36.61 (CI 33.5-39.71, SD± 23.132) days, while the median was 30 days. From the Skewness value (0.743) most of the values were clustered to the left at the low values while with 0.496) Kurtosis distribution of the cases seemed to be peaked with more cases clustered in the center.

Analysis of the patient's period (based on delayed or not delayed)

61.6% (133) of the study subjects showed a patient's period of more than 28days (4weeks) while 38.4% (83) showed a patient's period of less than or equal to 28 days.

On investigating the factors that predict the likelihood that a case had reported a patient's period of more than 28 days, analysis using binary logistic regression was performed , model fitting was tested using Omnibus test {n= 190, $x^2(18)=41.186$, p=0.001) and Homer and Lemeshow test {$x^2(8)=12.179$, p=0.143}both indicated a well fitting model. The amount of variation in the dependant variable explained by the model, according to Cox and Snell R^2 (0.19.5) and Nagelkerke R^2 (0.264), was 19.5 – 26.4%.

The model was 68.4% able to predict the correct category of each case according to the dependent variable i.e. patient's period (0=period $\leq$ 28 days, 1= period more than 28 days or). The sensitivity of the model was 80.9% and the specificity was 49.3%. The positive predictive value for the model was 70.99% and the negative predictive value was 62.71%.

From the results of the model the significant predictors for the patient' period being more than 28 days were, the age of the patients {Wald (df1) = 9.15, p=0.002, OR=0.3, CI= 0.137-0.654} indicating that those who fall into the group age between 25 and 54 were a predictor for having patient's period of more than 28 days when compared to those who fall outside this age group. Another significant predictor was mode of payment to public health unit {Wald (df1) = 5.287, p=0.021, OR=2.482, CI= 1.144-5.388} which indicated that having to pay for the service predicted patient's period of more than 28 days when compared to those who were not to pay any-thing. The OR was high. When considering sputum grading for AFB of the patient we found that having sputum grading of scanty or 1 + {Wald (df2) = 6.667, p=0.036} was a predictor for having a long patient's period when compared to those with 2 ++ {Wald (df1) = 6.45, p=0.011, OR=0.344, CI= 0.151-0.784}.

Other predictors like sex, marital status, education, occupation, distance to TBMU and residence were not found to be statistically significant as predictors.

Analysis of the patient's (based on group's comparison)

Age of the patient

The relationship between patient's period as measured by days and age of the patients as measured by years was investigated using Spearman's rank order correlation since the assumption of linearity did not satisfy the use of Pearson correlation. There was no significant correlation between the two variables {rho=-0.029, n=216, p=0.674).

A one way between groups analysis of variance was conducted to explore the impact of the patient's age on the patient's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.397) Subjects were divided into three groups according to their age (group 1: less than 25 years old; group 2: between 25 to 54 years old and group 3: more than 54 years old). There was a statistically significant difference at the $p<0.05$ level in patient's period for the three groups {F (2,213) = 3.405, p=0.035). Despite the statistical significance, the actual difference in mean scores between the groups was small. The effect size, calculated using eta squared, was 0.03.

Post Hoc comparisons using the Tukey HSD test indicated that the mean score for group 2 (M=39.67, SD=23.695) was significantly different from group 3 (M=29.57, SD=21.169). Group 1 (M=32.63, SD=21.563) didn't differ significantly from either group 2 or 3.

Gender

An independent-samples t-test was conducted to compare the patient's period for both sexes i.e. males and females. Despite males (M=38.1, SD= 24.149, n=137) showed a longer mean time than females (M=34.0, SD=21.147, n=79), there was no statistically significant difference in scores for males {t (214) = 1.259, p=0.209} the magnitude of the difference in the means was very small (eta squared =0.007).

Marital status

Kruskal Wallis test was conducted to explore the impact of patient's marital status on the patient's period as measured in days (Levene test for homogeneity of variance was significant, $p=0.002$). Subjects were divided into three groups according to their marital status (group 1: were singles; group 2: were married and group 3: were divorced or widows). Group 2 (Mean Rank=104.92, n=137) showed a shorter mean rank time than both group 1 (Mean Rank=115.3, n=65) and group 3 (Mean Rank=111.93, n=14), but there was no statistically significant difference between the three groups $\{x^2 = 1.274, df = 2, p = 0.529\}$.

Educational level

Kruskal Wallis test was conducted to explore the impact of patient's level of education on the patient's period as measured in days (Levene test for homogeneity of variance was significant, $p=0.004$). Subjects were divided into three groups according their years of formal educations (group 1: were having less than 3 years of formal education; group 2: were those with 3 to 6 years of formal education and group 3: were those with more than 6 years of formal education). Group 3 (Mean Rank=101.45, n=65) showed a shorter mean rank time when compared to both group 1 (Mean Rank=112.37, n=100) and group 2 (Mean Rank=109.91, n=51), but there was no statistically significant difference between the three groups $\{x^2 = 1.25, df = 2, p = 0.535\}$.

Occupation

Kruskal Wallis test was conducted to explore the impact of patient's occupation on the patient's period as measured in days (Levene test for homogeneity of variance was significant, $p=0.001$). Subjects were divided into three groups according their occupation (group 1: were students or without income generating activity; group 2: were laborers or farmers and group 3: were employees or others). Group 3 (Mean Rank=123.88, n=30) showed a longer mean rank period when compared to both group 1 (Mean Rank=100.01, n=93) and group 2 (Mean Rank=112.03, n=93), but there was no statistically significant difference between the three groups $p>0.05$ $\{x^2 = 3.875, df = 2, p = 0.144\}$.

Monthly income

An independent-samples t-test was conducted to compare the patient's period for patient's monthly income. Despite those with income less than 100 US$ per month (M=38.13, SD= 24.014, n=142) showed a longer mean period when compared to those with higher income (M=33.68, SD=21.185, n=74), there was no statistically significant difference in scores for those with less than 100 US$ per month {t (214) = 1.347, p=0.179}.

Residence

A one way between groups analysis of variance was conducted to explore the impact of patient's residence on the patient's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.28) Subjects were divided into three groups according to their residence (group 1: rural residence; group 2: suburban residence and group 3: urban residence). Group 1(M=37.75, SD=23.871, n=159) showed a longer mean period when compared to both group 2 (M=35.68, SD=20.744, n=41) and group 3 (M=27.56, SD=20.403, n=16) but there was no statistically significant difference between the three groups, p>0.05 {F (2, 213) = 1.458, p= 0.235}.

Housing conditions of the patients

Number of rooms per house

The relationship between patient's period as measured in days and housing condition as measured by number of rooms per patient's house was investigated using Spearman's rank order correlation since the assumption of linearity did not satisfy the requirement for using Pearson correlation. There was no correlation between the two variables {rho=-0.022, n=216, p=0.001).

Number of persons per house

The relationship between patient's period as measured in days and housing conditions of the patients as measured by number of persons sharing the same house was investigated using Spearman's rank order correlation since the assumption of linearity did not satisfy the requirement for using Pearson correlation. There was no correlation between the two variables {rho=-0.088, n=216, p=0.2).

Number of persons per room in the house

A one way between groups analysis of variance was conducted to explore the impact of the patient's housing condition on the patient's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.107) Subjects were divided into three groups according to the average number of persons per room (group 1: one person per room; group 2: between two and three persons per room and group 3: more than 4 persons per room). There was a statistically significant difference between the three groups {F (2,213) = 4.841, p=0.009). Despite the statistical significance, the actual difference in mean scores between the groups was small. The effect size, calculated using eta squared, was 0.04.

Post Hoc comparisons using the Tukey HSD test indicated that the mean score for group 2 (M=32.53, SD=20.54) was significantly different from group 3 (M=41.68, SD=25.58); p=0.013. Group 1 (M=46.5, SD=23.403) didn't differ significantly from either group 2 or 3.

Distance between residence and the TBMU

A one way between groups analysis of variance was conducted to explore the impact of the distance between patient's house and TBMU as measured by minutes of walking on the patient's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.111) Subjects were divided into three groups according to the distance measured by minutes of walking on feet (group 1: less than 15 minutes walk; group 2: between 15 to 30 minutes walk and group 3: more than 30 minutes walk). There was a statistically significant difference between the three groups {F (2,213) = 3.137, p=0.045). Despite the statistical significance, the actual difference in mean scores between the groups was small. The effect size, calculated using eta squared, was 0.03.

Post Hoc comparisons using the Tukey HSD test indicated that the mean score for group 2 (M=29.94, SD=20.788) was significantly different from group 3 (M=39.61, SD=24.463); p=0.037. Group 1 (M=37.51, SD=22.09) didn't differ significantly from either group 2 or 3 i.e. p>0.05.

Table 5.3: shows the relationship between socio demographic variables and patient's period:

Variable	n	Mean ± SD /Mean Rank	x^2 /F value	P value
Age				
< 25 years	51	32.63 ± 21.56		
25 – 54 years	135	39.67 ± 23.69	3.405	0.035
> 54 years	30	29.57 ± 21.17		
Sex				
Male	137	38.10 ± 21.15		
Female	79	34.00 ± 21.15	1.259	0.209
M. status				
Single	65	115.30		
Married	137	104.92	1.274	0.529
Divorced or widow	14	111.93		
Education				
< 3 years	100	112.37		
3-6 years	51	109.91	1.25	0.535
> 6 years	65	101.45		
Occupation				
Student or idle	93	100.01		
Laborer or farmer	93	112.03	3.875	0.144
Employee and others	30	123.88		
Monthly income				
<100 US$	142	38.13 ± 24.01		
> 100 US$	74	33.68 ± 21.19	1.347	0.179
No. person/room				
1	8	46.50 ± 23.40		
2-3	124	32.53 ± 20.54	4.841	0.009
≥4	84	41.68 ± 25.58		
Residence				
Rural	159	37.75 ± 23.87		
Sub urban	41	35.68 ± 20.74	1.458	0.235
Urban	16	27.56 ± 20.40		
Distance to TBMU				
<15 minutes	65	37.51 ± 22.09		
15-30 minutes	53	29.94 ± 20.79	3.137	0.045
> 30 minutes	98	39.61 ± 24.46		

Relating cough as a first symptom to the current illness

An independent-samples t-test was conducted to compare the patient's period for their referral to cough as the first symptom related to their current illness. There was no statistically significant difference in scores for those who reported cough as a first symptom related to their current illness {M=36.59, SD= 23.044, n=186) and those who referred to other symptoms (M=36.73, SD=24.072, n=30); t (214) = -0.032, p=0.974}.

Self-medication

An independent-samples t-test was conducted to compare the patient's period for the self-medication usage, there was no statistically significant difference in scores for those who recorded self-medication usage {M=39.28, SD= 21.93, n=72) to non-users (M=35.27, SD=23.671, n=144); t (214) = 1.201, p=0.231}.

Type of self-medication used

An independent-samples t-test was conducted to compare the patient's period for those who used traditional medication and those used modern medication. There was no significant difference in scores between those who used traditional medication first {M=43.84, SD= 22.974) and those who used modern medication {(M=35.79, SD=20.762); t (70) = 1.885, p=0.064}.

First medical provider visited

An independent-samples t-test was conducted to compare the patient's period for the type of first medical provider visited, there was no statistically significant difference in scores between those who first visited a private health provider (M=31.19, SD= 20.76, n=26) and those who visited public unit (M=37.35, SD=23.39, n=190); t (214) = -1.274, p=0.204}.

Mode of payment for the public health services

A one way between groups analysis of variance was conducted to explore the impact of mode of payment to the public health on the patient's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.902) Subjects were divided into three groups according to the type of payment (group 1: through health insurance system; group 2: for free and group 3: full payment). Group 1 (M=24.13, SD=23.593, n=16) showed a shorter mean period than both group 2 (M=39.16, SD=24.584, n=64) and group 3 (M=38.22, SD=22.234, n=110). But there was no significant difference between the three groups {F (2, 187) = 2.88, p= 0.059}.

The reason given by the patient for coming to the TBMU

A one way between groups analysis of variance was conducted to explore the impact of the reason given by the patient for coming to the TBMU on the patient's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.853) Subjects were divided into three groups according their answer to this question (group 1: referred by a medical provider; group 2: advised by a friend or relative and group 3: on their own initiative initiative). Group 3 (M=40.79, SD=21.571, n=42) showed a longer mean period when compared to both group 1 (M=37.45, SD=23.712, n=130) and group 2 (M=30.14, SD=21.976, n=44). But there was no statistically significant difference between the three groups {F (2, 213) = 2.528, p= 0.082}.

Sputum grading

Kruskal Wallis test was conducted to explore the impact of sputum grading of the patient's smears on the patient's period as measured in days (Levene test for homogeneity of variance was significant, p=0.023). Subjects were divided into three groups according to their sputum for AFB examination (group 1: scanty and 1 +; group 2: 2 ++ and group 3: 3 +++). There was a difference between the mean ranks of the three groups. Group 1 (Mean rank=129.08) had a longer patient's mean rank period compared to group 2 (Mean Rank=100.99) and group 3 (Mean Rank =94.24). This difference was statistically significant {x^2 =12.503, df= 2, p= 0.002}.

Table 5.4: shows the relationship between current illness variables and patient's period:

Variable	n	Mean ± SD/ Mean Rank	x^2 /F value	p value
1st symptom related current illness				
Cough	186	36.59 ± 20.04		
Other	30	36.73 ± 24.07	0.032	0.974
Self-medication use				
Yes	72	39.28 ± 21.93		
No	144	35.27 ± 23.67	1.201	0.231
Type of self-medication				
Traditional	25	43.84 ± 22.97		
Medical	47	35.79 ± 20.76	1.885	0.064
Type of 1st HP* visited				
Public	190	37.35 ± 23.39		
Private	26	31.19 ± 20.76	1.274	0.204
Mode of payment to PH facility**				
Free	64	39.16 ± 24.58		
Health insurance	16	24.13 ± 23.59	2.88	0.059
Full payment	110	38.22 ± 22.23		
Reason behind coming to TBMU				
Referred by OHP	130	37.45 ± 23.71		
Advised by friend	44	30.14 ± 21.98	2.528	0.082
On own initiative	42	40.79 ± 21.57		
Sputum grading				
Scanty / 1 +	73	129.08		
2 ++	79	100.99	12.503	0.002
3 +++	64	94.24		

* Health provider, ** public health

5.4. Total health system's period

Exploration

The shortest total health system's period was 2 days and the longest was 124 days. The mean total health system's period was 33.05 days (CI 29.76-36.34, SD± 24.536), while the median was 28 days. From the Skewness value (1.366) the majority of the cases were clustered to the left at the low values while with (2.105) Kurtosis distribution of the cases seemed to be peaked with more cases clustered in the center.

Relation ship between total health system's period, TBMU's period and other health provider's period

The relationship between total health system's period and other health provider's period was investigated using Pearson's product-moment correlation coefficient. Preliminary analysis was performed to ensure no violation of the assumption of linearity and homoscedasticity. A strong, positive correlation between the two variables {$r=0.994$, $n=216$, $p<0.001$} was found, with a long other health provider's period associated with a long total health providers period.

The relationship between total health system's period and TBMU's period was investigated using Pearson's product-moment correlation coefficient. Preliminary analysis was performed to ensure no violation of the assumption of linearity and homoscedasticity. A small correlation between the two variables was found to be not significant{$r=0.047$, $n=216$, $p=0.488$}.

Total health system's period (analysis based on a cut-off point for long and short periods) 79.2% (171) of the study subjects showed a total health system's period of more than 14 days (health system delay) while 20.8% (45) showed a total health system's period of less than or equal 14 days (none delay).

On investigating the factors that predict the likelihood that a case had reported a total health system's period of more than 14 days, analysis using binary logistic regression was performed. The model fitting was tested using Omnibus test {$n= 190$, $x^2(25) =84.15$, $p<0.001$) and Homer and Lemeshow test {$x^2(8) =11.5$, $p=0.175$} both indicated a well fitting model. The amount of variation in the dependant variable explained by the model, according to Cox and Snell R^2 (0.358) and Nagelkerke R^2 (0.566), was 35.8 – 56.6%.

The model was 87.9% able to predict the correct category of each case according to the dependent variable i.e. total diagnostic period (0=period ≤14 days, 1= period >14 days or). The sensitivity of the model was 94.1% and the specificity was 63.2%. The positive predictive value for the model was 91.1% and the negative predictive value was 72.7%.

On screening the results of the model, the significant predictors were; housing condition of the patient as measured by the average person per room in the house, where we found those with an average of one to two persons per room {Wald (df2) = 7.689, p=0.021} had lower risk of a health system's period more than 14 days when compared to those with average of three to four {B=+2.612, Wald (df1) = 7.583, p=0.006, OR=13.626, CI= 2.123-87.445} and those with average more than 4 persons per room {B=+2.168, Wald (df1) = 5.07, p=0.024, OR=8.741, CI= 1.324-57.701}.

Marital status of the patient was found to be a significant predictor for health system's delay more than 14 days married {B=+2.221, p=0.013, OR=9.213, CI= 1.583-53.6} were at higher risk compared to singles. Having education of more than 6 years was risk factor for having health system's delay of more than 14 days {B=+2.445, p=0. 023, OR=11.532, CI= 1.391-95.61} compared to those with less education.

Other variables like sex, age, occupation, monthly income, mode of payment to the public health unit and sputum grading for AFB were not found to be statistically significant predictors for the total health system's delay more than 14 days.

Total health system (based on group's comparison)

Age of the patient

The relationship between total health system's period as measured by days and age of the patients as measured by years was investigated using Spearman's rank order correlation since the assumption of linearity did not satisfy the use of Pearson correlation. There was no correlation between the two variables {rho=-0.065, n=216, p=0.344).

A one way between groups analysis of variance was conducted to explore the impact of patient's age group on the total health system's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.118) Subjects were divided into three groups according their age in years (group 1: less than 25 years old; group 2: between 25 and 54 years old and group 3: more than 54 years old). Group 1 (M=35.04, SD=26.815, n=51) showed a longer health system's period compared to both group 2 (M=32.63, SD=24.979, n=135) and group 3 (M=31.57, SD=18.177, n=30). But there was no significant difference between the three groups {F (2, 213) = 0.241, p= 0.786}.

Gender of the patients

An independent-samples t-test was conducted to compare the total health system's period for males and females. Females (M=38.66, SD= 23.335) showed a longer mean total health system's period than males (M=29.82, SD= 24.711), this difference was statistically significant {t (214) = -2.584, p=0.01}, but the effect of the difference was small (eta squared =0.03). When controlling for both monthly income and number of health of health providers visited this significance disappear (t = -0.029, p=0.977).

Marital status

A one way between groups analysis of variance was conducted to explore the impact of the patient's marital status on the total health system's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.076) Subjects were divided into three groups according to their current marital status (group 1: singles; group 2: married and group 3: widows or divorced). There was a statistically significant difference in total health system's period between the three groups {F (2,213) = 4.437, p=0.002). The actual difference in mean scores between the groups was medium. The effect size, calculated using eta squared, was 0.06.

Post Hoc comparisons using the Tukey HSD test indicated that the mean score for group 3 (M=55.21, SD=28.717) was significantly different from group 1 (M=32.02, SD=26.59, p=0.003) and Group 2 (M=31.28, SD=22.044, p=0.001), while there were no statistically significant difference between group 2 and group 1.

Educational level

A one way between groups analysis of variance was conducted to explore the impact of patient's educational level on the total health system's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.623) Subjects were divided into three groups according their level of education (group 1: have less than three years of formal education; group 2: between 3 and 6 years of formal education and group 3: more than 6 years of formal education). Group 1 (M=32.22, SD=23.903, n=100) showed a shorter mean period than both group 2 (M=34.12, SD=22.153, n=51) and group 3 (M=33.49, SD=27.441, n=65). But there was no significant difference between the three groups {F (2, 213) = 0.115, p= 0.891}.

Patient's occupation

A one way between groups analysis of variance was conducted to explore the impact of the patient's current occupation on the total health system's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.147) Subjects were divided into three groups according to their occupation (group 1: student or without income generating activities; group 2: laborers or farmers and group 3: governmental employees or others). There was a statistically significant difference in total health system's period between the three groups {F (2,213) = 4.247, p=0.016). But the actual difference in mean scores between the groups was small. The effect size, calculated using eta squared, was 0.04.

Post Hoc comparisons using the Tukey HSD test indicated that the mean score for group 3 (M=25.13, SD=26.262) was significantly different from group 1 (M=38.19, SD=25.655); p=0.029. While for Group 2 (M=30.46, SD=21.848). The difference was not statistically significant between group 1 and group 3.

Monthly income in US$

Mann-Whitney U test was conducted to compare the total health system's period to the monthly income, i.e. less than 100 US$ or more than 100 US$, since the assumption of equality of variances (Levene test for homogeneity of variance was significant, p<0.001) and ratio between the two categories (ratio >1.5) was not satisfactory to use an independent-sample t-test. Those with income more than 100 US$ per month (Mean Rank =132.5, n=74) showed a larger mean rank time than those with lesser income (Mean Rank=95.99, n=142), this difference was statistically significant {Z = -4.075, p<0.001}. The effect of the difference was medium (eta squared =0.07).

Residence of the patients

Kruskal Wallis test was conducted to explore the impact of patient's residence on the total health system's period as measured in days (Levene test for homogeneity of variance was significant, $p<0.001$). Subjects were divided into three groups according their residence (group 1: rural residences; group 2: semi urban residence and group 3: urban residence). Group 3 (Mean Rank=119.31, n=16) showed a longer mean rank period than both group 1 (Mean Rank=107.74, n=159) and group 2 (Mean Rank=107.23, n=41). But there were no statistically significant difference between the three groups {x^2 =0.52, df= 2, p= 0.771}.

Housing conditions of the patients

Number of rooms within patient's house

The relationship between total health system's period as measured by days and housing condition as measured by number of rooms per patient's house was investigated using Spearman's rank order correlation since the assumption of linearity did not satisfy the use of Pearson correlation. There was a positive correlation between the two variables which was significant {rho=0.144, n=216, p=0.035).

Number of persons per patient's house

The relationship between total health system's period as measured by days and housing conditions of the patients as measured by number of persons sharing the same house was investigated using Spearman's rank order correlation since the assumption of linearity did not satisfy the use of Pearson correlation. There was no correlation between the two variables {rho=-0.033, n=216, p=0.629).

Number of persons per room within patient's house

A one way between groups analysis of variance was conducted to explore the impact of the patient's housing condition as measured by the average persons per room on the total health system's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.62) Subjects were divided into three groups according to the average number of persons per room (group 1: 1 person per room; group 2: 2 or 3 persons per room and group 3: more than 4 persons per room). Group 2 (M=35.06, SD=23.812, n=124) showed a longer mean period when compared to both group 1 (M=21.13, SD=24.521, n=8) and group 3 (M=31.23, SD=25.405, n=84). But there was no statistically significant difference for health system's period between the three groups {$F(2,213) = 1.6$, p=0.204).

Distance to TBMU

A one way between groups analysis of variance was conducted to explore the impact of the distance between patient's house and TBMU, as measured by minutes of walking, on the total health system's period as measured in days. (Levene test for homogeneity of variance was not significant, $p=0.091$) Subjects were divided into three groups according to the distance walking on feet between their houses and TBMU as measured by minutes (group 1: distance was less than 15 minutes; group 2: between 15 and 30 minutes and group 3: more than 30 minutes). There was a statistically significant difference in total health system's period between the three groups {$F_{(2,213)} = 3.363$, $p=0.036$), the actual difference in mean scores between the groups was small. The effect size, calculated using eta squared, was 0.03.

Post Hoc comparisons using the Tukey HSD test indicated that the mean score for group 3 ($M=28.97$, $SD=19.729$) was significantly different from group 2 ($M=39.62$, $SD=30.49$); $p=0.029$. While for Group 1 ($M=33.85$, $SD=24.804$), difference was not statistically significant compared to group 2 or group 3.

Table 5.5: shows the relationship between socio demographic variables and total health system's period:

Variable	n	Mean ± SD /Mean Rank	x^2 /F/Z value	p value
Age				
< 25 years	51	35.04 ± 26.82		
25 – 54 years	135	32.63 ± 24.98	0.241	0.786
> 54 years	30	31.57 ± 18.18		
Sex				
Male	137	29.82 ± 24.71		
Female	79	38.66 ± 23.34	2.584	0.01
M. status				
Single	65	32.02 ± 26.59		
Married	137	31.28 ± 22.04	4.437	0.002
Divorced or widow	14	55.21 ± 28.72		
Education				
< 3 years	100	32.22 ± 23.90		
3-6 years	51	34.12 ± 22.15	0.115	0.891
> 6 years	65	33.49 ± 27.44		
Occupation				
Student or idle	93	38.19 ± 25.66		
Laborer or farmer	93	30.46 ± 21.85	4.247	0.016
Employee and others	30	25.13 ± 26.26		
Monthly income				
<100 US$	142	95.99		
> 100 US$	74	132.5	4.075	<0.001
No. person/room				
1	8	21.13 ± 24.52		
2-3	124	35.06 ± 23.81	1.6	0.204
≥4	84	31.23 ± 25.41		
Residence				
Rural	159	107.74		
Sub urban	41	107.23	0.52	0.771
Urban	16	119.31		
Distance to TBMU				
<15 minutes	65	33.85 ± 24.80		
15-30 minutes	53	39.62 ± 30.49	3.363	0.036
> 30 minutes	98	28.97 ± 19.73		

Relating cough as a first symptom for their current illness

Mann-Whitney U test was conducted to compare the total health system's period to the patients relating cough as a first symptom of their current illness. Since the assumption of equality of variances (Levene test for homogeneity of variance was significant, $p<0.027$) and ratio between the two categories (ratio >1.5) did not satisfy the use of an independent-sample t-test. Those who referred to cough as a first symptom related to their current illness (Mean Rank =110.6, n=186) showed a longer mean rank time than those who referred to other symptoms than cough (Mean Rank=95.42, n=30), but this difference was not statistically significant {Z = -1.236, p=0.216}.

Uses of self-medications

An independent-samples t-test was conducted to compare the total health system's period for those who used self-medication with non-users. Users of self-medication (M=31.51, SD= 22.206) showed a shorter mean time than nonuser of self-medication (M=33.82, SD= 25.662). But this difference was not statistically significant {t (214) = -0.65, p=0.516}.

Type of self-medication used

An independent-samples t-test was conducted to compare the total health system's period for those who used traditional medication and those used modern medication. There was significant difference in scores between those who used traditional medication first {M=40.2, SD= 23.338) and those who used modern (M=26.89, SD=20.35); t (70) = 2.509, p=0.014}. The magnitude of the difference in the means had a medium effect (eta squared =0.08).

First health provider visited

Mann-Whitney U test was conducted to compare the total health system's period to the type of first health provider visited, since the assumption of equality of variances (Levene test for homogeneity of variance was significant, $p<0.035$) and ratio between the two categories (ratio >1.5) did not satisfy the use of an independent-sample t-test. Those who firstly visited a public health provider (Mean Rank =106.99, n=190) showed a shorted mean rank time than those who first visited a private health provider (Mean Rank=119.5, n=26). But this difference was not statistically significant {Z = -0.957, p=0.338}.

Type of investigation performed before reaching the TBMU

An independent-samples t-test was conducted to compare the total health system's period for those patient's who had X-Ray investigation and those who had blood investigations. There was a significant difference in scores between those who received X-ray {M=27.99, SD= 24.062) and those who had blood investigations (M=41.97, SD=24.304); t (168) = 3.699, p<0.001}. The magnitude of the difference in the means had a medium effect (eta squared =0.07).

Mode of payment for the public health provider

Kruskal Wallis test was conducted to explore the impact of the mode of payment to the public health providers on the total health system's period as measured in days (Levene test for homogeneity of variance was significant, p=0.005). Subjects were divided into three groups according to the way they paid for the public health providers (group 1: through health insurance; group 2: free and group 3: full payment). Group 2 (Mean rank=81.47) showed a shorter mean rank period compared to group 1 (Mean Rank=104.25) and group 3 (Mean Rank =102.39). The difference between the three groups was statistically significant {x^2 =6.303, df= 2, n=190, p= 0.043}.

Number of health providers visited before TBMU

The relationship between total health system's period as measured by days and number of health providers visited before TBMU as measured by number of health providers visited was investigated using Pearson product-moment correlation. Preliminary analysis was performed to ensure no violation of the assumption of linearity and homoscedasticity. There was a strong positive correlation between the two variables {r= 0.604, n=216, p<0.001}, with a long health system's periods largely associated with higher number of health providers being visited before reaching the TBMU.

Kruskal Wallis test was conducted to explore the impact of the number of health providers visited before reaching TBMU on the total health system's period as measured in days (Levene test for homogeneity of variance was significant, $p<0.001$). Subjects were divided into three groups according to the number of health providers visited before TBMU (group 1: 1 or none; group 2: 2 to 4 health providers and group 3: 5 or more health providers). Group 1 (Mean rank=74.18) showed a shorter mean rank period compared to group 2 (Mean Rank=143.59) and group 3 (Mean Rank =186.13). The difference between the three groups was statistically significant {x^2 =86.141, df= 2, n=216, $p< 0.001$}.

The reason given by the patient for coming to the TBMU

Kruskal Wallis test was conducted to explore the impact of the reasons given by the patient for coming to the TBMU on the total health system's period as measured in days (Levene test for homogeneity of variance was significant, $p<0.001$). Subjects were divided into three groups according to the reason of why coming to the TBMU (group 1: referred by medical provider; group 2: advised by a friend of a relative and group 3: on their own initiative). Group 3 (Mean Rank=116.89, n=44) showed a longer mean rank period when compared to both group 1 (Mean Rank=110.47, n=130) and group 2 (Mean Rank=93.61). But there was no statistically significant difference between the three groups {x^2 =3.309, df= 2, n=216, p= 0.191}.

Sputum grading

Kruskal Wallis test was conducted to explore the impact of the sputum grading for AFB on the total health system's period as measured in days (Levene test for homogeneity of variance was significant, $p<0.01$). Subjects were divided into three groups according to their sputum for AFB results (group 1: scanty or 1+; group 2: 2 ++ and group 3: 3 +++). Despite those of group 3 (Mean Rank=121.27) seems to have a longer period when compared to group 1(Mean Rank =100.61) and group 2 (Mean Rank = 105.45), this difference was not statistically significant {x^2 =4.024, df= 2, n=216, p= 0.134}.

Table 5.6: shows the relationship between current illness variables and total health system's period:

Variables	n	Mean ± SD/ Mean Rank	x^2 /F/Z value	p value
1st symptom related current illness				
Cough	186	110.6		
Other	30	95.42	1.236	0.216
Self-medication use				
Yes	72	31.51 ± 22.21		
No	144	33.82 ± 25.66	0.65	0.516
Type of self-medication				
Traditional	25	40.20 ± 23.34		
Medical	47	26.89 ± 20.35	2.509	0.014
Type of 1st HP* visited				
Public	190	106.99		
Private	26	119.5	0.957	0.338
Type of investigation performed				
X Ray	69	27.99 ± 24.06		
Others	101	41.97 ± 24.30	3.699	<0.001
Mode of payment to PH facility**				
Free	64	81.47		
Health insurance	16	104.25	6.303	0.043
Full payment	110	102.39		
No. of HP visited before TBMU				
1 or none	119	74.18		
2-4	81	143.59	86.141	<0.001
5 or more	16	186.13		
Reason behind coming to TBMU				
Referred by OHP	130	110.47		
Advised by friend	44	93.61	3.309	0.191
On own initiative	42	116.89		
Sputum grading				
Scanty / 1 +	73	100.6		
2 ++	79	105.45	4.024	0.134
3 +++	64	121.27		
No. of health providers visited before reaching the TBMU†	216		r= 0.604	<0.001

* Health provider, ** public health, † results of Pearson correlation

5.5. Other health provider's period

Exploration

The shortest other health provider's period was 0 days and the longest other health provider's period was 120 days. The mean other health provider's period was 29.11 days (CI 25.79-32.43, SD± 24.733), while the median was 24 days. From the Skewness value (1.356) the majority of the cases were clustered to the left at the low values while with (2.061) Kurtosis distribution of the cases seemed to be peaked with more cases clustered in the center.

78.7% (170) of the study subjects showed other health provider's period of more than 9 days while 21.3% (46) showed other health provider's period of less than 10 days.

Other health providers (group comparison)

Age

The relationship between other health provider's period as measured by days and age of the patients as measured by years was investigated using Spearman's rank order correlation since the assumption did not satisfy the use of Pearson correlation. There was no correlation between the two variables {rho=-0.069, n=216, p=0.309).

A one way between groups analysis of variance was conducted to explore the impact of patient's age group on the other health provider's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.118) Subjects were divided into three groups according their age in years (group 1: less than 25 years old; group 2: between 25 and 54 years old and group 3: more than 54 years old). Despite the difference in means that showed a shorter period for group 3 (M=26.7, SD=18.366, n=30) compared to group 2 (M=29.06, SD=25.078, n=135) and group 1 (M=30.67, SD=27.264, n=51), this difference was not statistically significant {F (2, 213) = 0.241, p= 0.785}.

Gender of the patient

An independent-samples t-test was conducted to compare the other health provider's period for males and females. Females (M=38.66, SD= 23.335, n=79) showed a longer mean time than males (M=29.82, SD= 24.711, n=137). This difference was statistically significant {t (214) = -2.584, p=0.01}. But the effect of the difference was small (eta squared =0.03). When controlling for both family monthly income and number of health of health providers visited this significance disappear (t =0.151, p=0.88).

Marital status

A one way between groups analysis of variance was conducted to explore the impact of the patient's current marital status on the other health provider's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.105) Subjects were divided into three groups according to their marital status (group 1: singles; group 2: married and group 3: widows or divorced). There was a statistically significant difference in other health provider's period between the three groups {F (2,213) = 6.438, p=0.002). The actual difference in mean scores between the groups was medium. The effect size, calculated using eta squared, was 0.06.

Post Hoc comparisons using the Tukey HSD test indicated that the mean score for group 3 (M=51.43, SD=28.651, n=14) was significantly different from group 1 (M=28.22, SD=26.743, n=65, p=0.004) and Group 2 (M=27.26, SD=22.291, n=137, p=0.001), while there was no statistically significant difference between group 2 and group 1.

Educational level

A one way between groups analysis of variance was conducted to explore the impact of patient's educational level as measured by years of formal education on the other health provider's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.708) Subjects were divided into three groups according their forma l years of education (group 1: have less than 3 years of formal education; group 2: between 3 and 6 years of formal education and group 3: more than 6 years of formal education). Despite the difference in means showed a shorter period for group 1 (M=28.76, SD=23.885, n=100) compared to group 2(M=29.37, SD=22.544, n=51) and group 3 (M=29.45, SD=27.841, n=65) the difference was not statistically significant {F (2, 213) = 0.019, p= 0.981}.

Patient's occupation

A one way between groups analysis of variance was conducted to explore the impact of the patient's current occupation on the other health provider's period as measured in days. (Levene test for homogeneity of variance was not significant, $p=0.081$) Subjects were divided into three groups according to their occupation (group 1: student or without income generating activities; group 2: laborers or farmers and group 3: governmental employees or others). There was a statistically significant difference in other health provider's period for the three groups {$F(2,213) = 4.311$, $p=0.015$). The actual difference in mean scores between the groups was small. The effect size, calculated using eta squared, was 0.04.

Post Hoc comparisons using the Tukey HSD test indicated that the mean score for group 3 ($M=20.93$, $SD=26.647$, $n=30$) was significantly different from group 1 ($M=34.3$, $SD=25.937$, $n=93$, $p=0.026$), while for Group 2 ($M=26.5$, $SD=21.86$, $n=93$) the difference was not statistically significant versus group 1 or group 3.

Family monthly income in US$

Mann-Whitney U test was conducted to compare the other health provider's period to the patient's monthly income, i.e. less than 100 US$ or more than 100 US$, since the assumption of equality of variances (Levene test for homogeneity of variance was significant, $p<0.001$) and ratio between the two categories (ratio >1.5) did not satisfy the use of an independent-sample t-test. Those with income more than 100 US$ per month (Mean Rank $=132.3$, $n=74$) showed a larger mean rank time than those with lesser income (Mean Rank$=96.1$, $n=142$). This difference was statistically significant {$Z = -4.046$, $p<0.001$}. The effect of the difference was medium (eta squared $=0.07$).

Patient's residence

Kruskal Wallis test was conducted to explore the impact of patient's residence on the other health provider's period as measured in days (Levene test for homogeneity of variance was significant, $p<0.001$). Subjects were divided into three groups according their residence (group 1: rural residences; group 2: semi urban residences and group 3: urban residences). Group 3 (Mean Rank$=119.30$, $n=16$) showed a longer mean rank period than both group 1 (Mean Rank=107.74, n=159) and group 2 (Mean Rank=107.23, n=41). But there were no statistically significant difference between the three groups {x^2 =0.52, df= 2, p= 0.771}.

Patient's housing conditions

Number of rooms per patient's house

The relationship between other health provider's period as measured by days and housing condition as measured by number of rooms per patient's house was investigated using Spearman's rank order correlation since the assumption of linearity did not satisfy the use of Pearson correlation. There was a positive correlation between the two variables which was not significant {rho=0.131, n=216, p=0.055).

Number of persons sharing the same house with the patient

The relationship between other health provider's period as measured by days and housing conditions of the patients as measured by number of persons sharing the same house was investigated using Spearman's rank order correlation since the assumption of linearity did not satisfy the use of Pearson correlation. There was no correlation between the two variables {rho=0.031, n=216, p=0.647).

Number of persons per room within patient's house

A one way between groups analysis of variance was conducted to explore the impact of the patient's housing condition on the other health provider's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.562) Subjects were divided into three groups according to the average number of persons per room (group 1: 1 person per room; group 2: 2 or 3 persons per room and group 3: more than 4 persons per room). Group 2 (M=31.03, SD=23.955, n=124) showed a longer mean period than both group 1 (M=16.88, SD=25.25, n=8) and group 3 (M=27.44, SD=25.645, n=84). But there was no statistically significant difference for health system's period between the three groups {F (2,213) = 1.553, p=0.214).

Distance to the TBMU

A one way between groups analysis of variance was conducted to explore the impact of the distance between patient's house and TBMU as measured by minutes walking on the other health provider's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.087) Subjects were divided into three groups according to the distance walking on feet between their houses and TBMU as measured by minutes (group 1: less than 15 minutes; group 2: between 15 and 30 minutes and group 3: more than 30 minutes). There was no statistically significant difference for the other health provider's period between the three groups {F (2,213) = 2.94, p=0.055). The actual difference in mean scores between the groups was small. The effect size, calculated using eta squared, was 0.03.

The Post Hoc comparisons using the Tukey HSD test indicated that the mean score for group 3 (M=25.32, SD=19.851, n=98) was significantly different from group 2 (M=35.26, SD=30.723, n=53, p=0.045), while for Group 1 (M=29.95, SD=25.211, n=65), difference was not statistically significant versus group 2 or group 3.

Table 5.7: shows the relationship between socio demographic variables and other health provider's period.

Variable	n	Mean ± SD /Mean Rank	x^2 /F/Z value	p value
Age				
< 25 years	51	30.67 ± 27.26		
25 – 54 years	135	29.06 ± 25.08	0.214	0.785
> 54 years	30	26.70 ± 18.37		
Sex				
Male	137	29.82 ± 24.71		
Female	79	38.66 ± 23.34	2.584	0.01
M. status				
Single	65	28.22 ± 26.74		
Married	137	27.26 ± 22.29	6.438	0.002
Divorced or widow	14	51.43 ± 28.65		
Education				
< 3 years	100	28.76 ± 23.89		
3-6 years	51	29.37 ± 22.54	0.019	0.981
> 6 years	65	29.45 ± 27.84		
Occupation				
Student or idle	93	34.30 ± 25.94		
Laborer or farmer	93	26.50 ± 21.86	4.311	0.015
Employee and others	30	20.93 ± 26.65		
Monthly income				
<100 US$	142	96.1		
> 100 US$	74	132.3	4.046	<0.001
No. person/room				
1	8	16.88 ± 25.25		
2-3	124	31.03 ± 23.96	1.553	0.214
≥4	84	27.44 ± 25.65		
Residence				
Rural	159	107.74		
Sub urban	41	107.23	0.52	0.771
Urban	16	119.3		
Distance to TBMU				
<15 minutes	65	29.95 ± 25.21		
15-30 minutes	53	35.20 ± 30.72	2.94	0.055
> 30 minutes	98	25.32 ± 19.85		

Cough as a first symptom related to patient's current illness

Mann-Whitney U test was conducted to compare the other health provider's period to the patients relating cough as a first symptom to their current illness, since the assumption of equality of variances (Levene test for homogeneity of variance was significant, $p<0.027$) and ratio between the two categories (ratio >1.5) did not satisfy the use of an independent-sample t-test. Those who referred to cough as a first symptom related to their current illness (Mean Rank =110.97, n=186) showed a longer mean rank time than those who referred to other symptoms than cough (Mean Rank=93.2, n=30). But this difference was not statistically significant {Z = -1.447, p=0.148}

Self-medication usage

An independent-samples t-test was conducted to compare the other health provider's period for those who used self-medication with non-users. Users of self-medication (M=31.51, SD= 22.206) showed a shorter mean time than non-user of self-medication (M=33.82, SD= 25.662). But this difference was not statistically significant {t (214) = -0.65, p=0.516}.

First health provider visited

Mann-Whitney U test was conducted to compare the other health provider's period to the type of the first health provider visited, since the assumption of equality of variances (Levene test for homogeneity of variance was significant, $p<0.035$) and ratio between the two categories (ratio >1.5) did not satisfy the use of an independent-sample t-test. Those who firstly visited a public health provider (Mean Rank =107.14, n=190) showed a shorter mean rank time than those who first visited a private health provider (Mean Rank=118.46, n=26). But this difference was not statistically significant {Z = -0.868, p=0.386}.

Mode of payment for public health units

Kruskal Wallis test was conducted to explore the impact of the mode of payment to the public health providers on the other health provider's period as measured in days (Levene test for homogeneity of variance was significant, p=0.006). Subjects were divided into three groups according to the way they paid for the public health providers (group 1:

through health insurance; group 2: free and group 3: full payment). There was a difference between the mean ranks of the three groups. Group 2 (Mean rank=81.47, n=64) had a shorter time compared to group 1 (Mean Rank=104.25, n=16) and group 3 (Mean Rank =102.39, n=110). This difference was statistically significant {x^2 =6.303, df= 2, n=190, p= 0.043}.

Number of health providers visited before TBMU

The relationship between other health provider's period as measured by days and number of health providers visited before TBMU as measured by number of health providers visited was investigated using Pearson product-moment correlation. Preliminary analysis was performed to ensure no violation of the assumption of linearity and homoscedasticity. There was a strong positive correlation between the two variables {r= 0.606, n=216, p<0.001}, with a long other health provider's periods associated with higher number of medical providers being visited before the TBMU.

Kruskal Wallis test was conducted to explore the impact of the number of health providers visited before reaching TBMU on the other health provider's period as measured in days (Levene test for homogeneity of variance was significant, p<0.001). Subjects were divided into three groups according to the number of health providers visited before TBMU (group 1: 1 or none; group 2: 2 to 4 health providers and group 3: 5 or more health providers). Group 1 (Mean rank=74.36) showed a shorter mean rank period compared to group 2 (Mean Rank=143.25) and group 3 (Mean Rank =186.5). The difference between the three groups was statistically significant {x^2 =85.709, df= 2, n=216, p< 0.001}.

The reason given by the patient for coming to the TBMU

The Kruskal Wallis test was conducted to explore the impact of the reason given by the patient for coming to the TBMU on the other health provider's period as measured in days (Levene test for homogeneity of variance was significant, p<0.001). Subjects were divided into three groups according to the reason of why coming to the TBMU (group 1: referred by medical provider; group 2: advised by a friend or a relative and group 3: on their own initiative). There were no statistically significant difference between the three groups {group1 (Mean Rank=110.47, n=130); group 2 (Mean Rank=116.89, n=44); group 3 (Mean Rank=93.61, n=42)}. {x^2 =3.309, df= 2, n=216, p= 0.191}.

Patient's AFB sputum grading

Kruskal Wallis test was conducted to explore the impact of the sputum grading for AFB on the other health provider's period as measured in days (Levene test for homogeneity of variance was significant, $p<0.02$). Subjects were divided into three groups according to their sputum for AFB results (group 1: scanty or 1+; group 2: 2 ++ and group 3: 3 +++). Despite those of group 3 (Mean Rank=121.27, n=64) seems to have a longer mean rank period when compared to group 1(Mean Rank =100.61, n=73) and group 2 (Mean Rank = 105.45, n=79), this difference was not statistically significant {x^2 =4.024, df= 2, n=216, p= 0.134}.

Table 5.8: shows the relation ship between the current illness variables and other health provider's period.

Variables	n	Mean ± SD/ Mean Rank	x^2 /F/Z value	p value
1st symptom related current illness				
Cough	186	110.97		
Other	30	93.20	1.447	0.148
Self-medication use				
Yes	72	31.51 ± 22.21		
No	144	33.82 ± 25.66	0.65	0.516
Type of 1st HP* visited				
Public	190	107.14		
Private	26	118.46	0.868	0.386
Mode of payment to PH facility**				
Free	64	81.47		
Health insurance	16	104.25	6.303	0.043
Full payment	110	102.39		
No. of HP visited before TBMU				
1 or none	119	74.36		
2 -4	81	143.25	85.709	<0.001
5 or more	16	186.5		
Reason behind coming to TBMU				
Referred by OHP	130	110.47		
Advised by friend	44	116.89	3.309	0.191
On own initiative	42	93.61		
Sputum grading				
Scanty / 1 +	73	100.61		
2 ++	79	105.45	4.024	0.134
3 +++	64	121.27		
No. of health providers visited before reaching the TBMU†	216		r= 0.606	<0.001

* Health provider, ** public health, † results of Pearson correlation

5.6. TBMU's period

Exploration

The shortest TBMU's period was 2 days and the longest TBMU's period was 9 days. The mean TBMU's period was 3.99 days (CI 3.76-4.21, SD± 1.649), while the median was 4 days. From the Skewness value (1.077) the majority of the cases were clustered to the left at the low values while with (0.846) Kurtosis distribution of the cases seemed to be peaked with more cases clustered in the center.

14.8% (32) of the study subjects showed a TBMU's period of more than 5 days while 85.2% (184) showed TBMU's period of less than or equal to 5 days.

TBMU's period (Group comparison)

Age

The relationship between TBMU's period as measured by days and age of the patients as measured by years was investigated using Spearman's rank order correlation since the assumption of linearity did not satisfy the use of Pearson correlation. There was no correlation between the two variables {rho=0.049, n=216, p=0.471).

A one way between groups analysis of variance was conducted to explore the impact of patient's age group on the TBMU's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.639) Subjects were divided into three groups according their ages in years (group 1: less than 25 years old; group 2: between 25 and 54 years old and group 3: more than 54 years old). There was a statistically significant difference in TBMU's period between the three groups {F (2,213) = 4.093, p=0.018). But the actual difference in mean scores between the groups was small. The effect size, calculated using eta squared, was 0.04.

Post Hoc comparisons using the Tukey HSD test indicated that the mean score for group 3 (M=4.6, SD=1.61, n=30) was significantly different from group 2 (M=3.76, SD=1.557, n=135) while for Group 1 (M=4.24, SD=1.807, n=51) was not statistically significant for group 2 or group 3.

Gender of the patient

An independent-samples t-test was conducted to compare the TBMU's period for males and females. Females ($M=4.0$, $SD= 1.601$, $n=79$) showed a longer mean time than males ($M=3.98$, $SD= 1.682$, $n=137$), but this difference was not statistically significant {$t(214) = -0.094$, $p=0.925$}.

Marital status

Kruskal Wallis test was conducted to explore the impact of the patient's current marital status on the TBMU's period as measured in days (Levene test for homogeneity of variance was significant, $p<0.007$). Subjects were divided into three groups according to their marital status (group 1: singles; group 2: married and group 3: divorced or widow). Despite those of group 1 (Mean Rank=102.73, n=65) seems to have a shorter TBMU's period compared to group 2 (Mean Rank =110.65, n=137) and group 3 (Mean Rank = 114.29, n=14), this difference was not statistically significant {$x^2 =0.883$, $df= 2$, $n=216$, $p= 0.643$}.

Educational level

A one way between groups analysis of variance was conducted to explore the impact of patient's educational level as measured by the number of formal educational years on the TBMU's period as measured in days. (Levene test for homogeneity of variance was not significant, $p=0.081$) Subjects were divided into three groups according their level of education (group 1: have less than 3 years of formal education; group 2: between 3 and 6 years of formal education and group 3: more than 6 years of formal education). Despite the difference in means that showed a shorter mean period for group 1 ($M=3.77$, $SD=1.51$, $n=100$) when compared to group 2 ($M=4.27$, $SD=1.898$, $n=51$) and group 3 ($M=4.09$, $SD=1.627$, $n=65$) differences were not statistically significant {$F(2, 213) = 1.786$, $p= 0.081$}.

Patient's occupation

A one way between groups analysis of variance was conducted to explore the impact of the patient's occupation on the TBMU's period as measured in days. (Levene test for homogeneity of variance was not significant, $p=0.278$) Subjects were divided into three groups according to their occupation (group 1: student or without income generating activities; group 2: laborers or farmers and group 3: governmental employees or others). Despite group 3 ($M=3.67$, $SD=1.539$, $n=30$) had a shorter mean period when compared to both group 1($M=3.99$, $SD=1.585$, $n=93$) and group 2 ($M=4.09$, $SD=1.749$, $n=93$), this difference was not a statistically significant {$F(2,213) = 0.732$, $p=0.483$),

Family monthly income in US$

An independent-samples t-test was conducted to compare the TBMU's period for the monthly income of the patient i.e. more than 100 US$ or less than 100 US$. Those with income more than 100 US$ per month ($M=4.01$, $SD= 1.635$, $n=142$) showed a longer mean time than those with more than 100 US$ per month ($M=3.95$, $SD= 1.687$, $n=74$). But this difference was not statistically significant {$t(214) = 0.258$, $p=0.797$}.

Patient's residence

A one way between groups analysis of variance was conducted to explore the impact of the patient's residence on the TBMU's period as measured in days. (Levene test for homogeneity of variance was not significant, $p=0.482$) Subjects were divided into three groups according to where they resided (group 1: rural; group 2: semi-urban and group 3: urban). Despite group 1 ($M=4.09$, $SD=1.711$, $n=159$) had a longer TBMU's period when compared to both group 2 ($M=3.76$, $SD=1.41$, $n=41$) and group 3 ($M=3.56$, $SD=1.548$, $n=16$) the difference was not statistically significant for TBMU's period between the three groups {$F(2,213) = 1.233$, $p=0.294$).

Patient's housing conditions

Number of rooms per patient's house

The relationship between TBMU's period as measured by days and housing condition as measured by number of rooms per patient's house was investigated using Spearman's rank order correlation since the assumption of linearity did not satisfy the use of Pearson correlation. There was a positive correlation between the two variables but the correlation was not significant {rho=0.126, n=216, p=0.063).

Number of persons sharing the same house with the patient

The relationship between TBMU's period as measured by days and housing conditions of the patients as measured by number of persons sharing the same house was investigated using Spearman's rank order correlation since the assumption of linearity did not satisfy the use of Pearson correlation. There was no correlation between the two variables {rho=0.039, n=216, p=0.572).

Number of persons per room within patient's house

Kruskal Wallis test was conducted to explore the impact of the housing conditions of the patient as measured by the average persons per room on the TBMU's period as measured in days (Levene test for homogeneity of variance was significant, p=0.039). Subjects were divided into three groups according to the average number of persons per each room of the house (group 1: 1 person per each room; group 2: 2 or 3 persons per each room and group 3: more than 4 persons per each room). There was a difference between the mean rank of the three groups, this difference showed a shorter period for group 3 (Mean rank=95.45, n=84) compared to group 1 (Mean Rank=114.75, n=8) and group 2 (Mean Rank =116.94, n=124). This difference was statistically significant {x^2 =6.351, df= 2, n=216, p= 0.042}.

Distance to the TBMU

Kruskal Wallis test was conducted to explore the impact of the distance walking on foot between patient's house as measured in minutes and TBMU on the TBMU's period as measured in days (Levene test for homogeneity of variance was significant, p=0.016). Subjects were divided into three groups according to the time in minutes of walking from patient's house to the TBMU (group 1: less than 15 minutes; group 2: 15 to 30 minutes and group 3: more than 30 minutes). There was a difference between the mean rank of the three groups, this difference showed a longer TBMU's period for group 2 (Mean rank=131.21, n=53) when compared to group 1 (Mean Rank=96.44, n=65) and group 3 (Mean Rank

=104.22, n=98). This difference was statistically significant {x^2 =10.445, df= 2, n=216, p= 0.005}.

Table 5.9: shows the relation ship between patient socio demographic variables and TBMU's period.

Variable	**n**	**Mean ± SD /Mean Rank**	**x^2 /F/Z value**	**p value**
Age				
< 25 years	51	4.24 ± 1.81		
25 – 54 years	135	3.76 ± 1.56	4.093	0.018
> 54 years	30	4.60 ± 1.61		
Sex				
Male	137	3.98 ± 1.68		
Female	79	4.00 ± 1.60	0.094	0.925
M. status				
Single	65	102.73		
Married	137	110.65	0.883	0.643
Divorced or widow	14	114.29		
Education				
< 3 years	100	3.77 ± 1.51		
3-6 years	51	4.27 ± 1.90	1.786	0.081
> 6 years	65	4.09 ± 1.63		
Occupation				
Student or idle	93	3.99 ± 1.59		
Laborer or farmer	93	4.09 ± 1.75	0.732	0.483
Employee and others	30	3.67 ± 1.54		
Monthly income				
<100 US$	142	4.01 ± 1.64		
> 100 US$	74	3.95 ± 1.69	0.258	0.797
No. person/room				
1	8	114.75		
2-3	124	11.94	6.351	0.042
≥4	84	95.45		
Distance to TBMU				
<15 minutes	65	96.44		
15-30 minutes	53	131.21	10.445	0.005
> 30 minutes	98	104.22		

Cough as a first symptom related to patient's current illness

An independent-samples t-test was conducted to compare the TBMU's period for the first symptom related to the patient's current illness i.e. those who mentioned cough as a first symptom related to their current illness with those who mentioned other symptoms. Those who mentioned cough (M=3.96, SD= 1.585, n=186) showed a shorter mean period than those who mentioned other symptoms (M=4.13, SD= 2.03, n=30). But this difference was not statistically significant {t (214) =- 0.526, p=0.599}.

First health provider visited

An independent-samples t-test was conducted to compare the TBMU's period for the type of health provider visited first i.e. public or private. Those who visited a private health provider (M=3.46, SD= 1.476) showed a shorter mean period than those who visited a public health provider (M=4.06, SD= 1.662). But this difference was not statistically significant {t (214) = -1.737, p=0.084}.

Mode of payment for public health units

A one way between groups analysis of variance was conducted to explore the impact of the mode of payment for the public health provider on the TBMU's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.576) Subjects were divided into three groups according to the way they paid for the public health (group 1: health insurance; group 2: free and group 3: full payment). Despite group 1 (M=4.75, SD=1.84, n=16) had a longer mean period compared to both group 2 (M=4.05, SD=1.666, n=64) and group 3 (M=3.96, SD=1.625, n=110), the difference was not statistically significant {F (2,187) = 1.574, p=0.21).

The reason given by the patient for coming to the TBMU

A one way between groups analysis of variance was conducted to explore the impact of the reason given by the patient for coming to the TBMU on the TBMU's period as measured in days. (Levene test for homogeneity of variance was not significant, p=0.809) Subjects were divided into three groups according to the reason behind coming to the TBMU (group 1: referred by medical provider; group 2: advised by a friend or relative and group 3: on their own initiative). Despite group 3 (M=4.24, SD=1.527, n=42) had a longer mean period when compared to both group 1(M=3.95, SD=1.637, n=130) and group 2 (M=3.84, SD=1.804, n=44), but this difference was not a statistically significant {F (2,213) = 0.683, p=0.506).

Patient's AFB sputum grading

Kruskal Wallis test was conducted to explore the impact of the sputum for AFB grading on the TBMU's period as measured in days (Levene test for homogeneity of variance was significant, p=0.009). Subjects were divided into three groups according to their sputum for AFB results (group 1: scanty or 1 +; group 2: 2 ++ and group 3: 3 +++). There was a difference between the mean rank of the three groups with a shorter TBMU's period for group 3 (Mean rank=88.58, n=64) compared to group 1 (Mean Rank=117.1, n=73) and group 2 (Mean Rank =116.7, n=79). This difference was statistically significant {x^2 =9.773, df= 2, n=216, p= 0.008}.

Table 5.10: shows the relationship between TBMU's period and current illness variables.

Variables	n	Mean ± SD/ Mean Rank	x^2 /F/Z value	p value
1st symptom related current illness				
Cough	186	3.96 ± 1.59		
Other	30	4.13 ± 2.03	0.526	0.599
Type of 1st HP* visited				
Public	190	4.06 ± 1.66		
Private	26	3.46 ± 1.48	1.737	0.084
Mode of payment to PH facility**				
Free	64	4.05 ± 1.67		
Health insurance	16	4.75 ± 1.84	1.574	0.21
Full payment	110	3.96 ± 1.63		
Reason behind coming to TBMU				
Referred by OHP	130	3.95 ± 1.64		
Advised by friend	44	3.84 ± 1.80	0.683	0.506
On own	42	4.24 ± 1.53		
Sputum grading				
Scanty / 1 +	73	117.1		
2 ++	79	116.7	9.773	0.008
3 +++	64	88.58		

* Health provider, ** public health

5.7. Post referral period

We defined it as a time period, for those who were referred to the TBMU by another health provider, from the date of referral to the date they reached the TBMU.

In our study from those 130 cases referred by other health providers to the TBMUs we found a mean post referral period of 4.32 ± 6.87 days, (median was 1.0 day).

When looking at patient’s socio demographic characteristics, we found that being of age more than 54 years was linked to longer mean rank post referral period when compared to those younger than 54 years (Kruskal Wallis test). Other significant variables with a longer mean rank post referral period were being divorced; having formal education of less than 6 years; and being residing in rural area.

Table 5.11: shows the relationship between patient's socio demographic characters and post referral period in 130 cases. (For dichotomous variables independent sample t test was performed. For variables with more than 3 subgroups Kruskal Wallis test was used)

Variable	**n**	**Mean ± SD Mean Rank**	**F/x^2 value**	**p value**
Age				
< 25 years	28	47.84		
25 – 54 years	79	67.91	10.72	0.005
> 54 years	23	78.72		
Sex				
Male	73	4.1 ± 6.52		
Female	57	4.6 ± 7.34	1.968	0.682
M. status				
Single	34	48.71		
Married	88	69.81	12.846	0.002
Divorced or widow	8	89.50		
Education				
< 3 years	65	68.29		
3-6 years	35	77.07	13.519	0.001
> 6 years	30	45.95		
Occupation				
Student or idle	63	62.57		
Laborer or farmer	54	69.91	1.468	0.48
Employee and others	13	61.38		
Monthly income				
<100US$	88	4.35 ± 6.58		
> 100 US$	42	4.24 ± 7.522	0.08	0.93
Residence				
Rural	96	70.16		
Sub urban	26	58.04	9.356	0.009
Urban	8	33.88		
Distance to TBMU				
<15 minutes	39	60.15		
15-30 minutes	28	66.89	1.319	0.517
> 30 minutes	63	68.19		

The difference in mode of payment to the public health facility was found statistically significant using Kruskal Wallis test, where those who had the service for free showed the longest mean rank period compared to both whom paid the full fee or covered by health insurance system. Another significant variable using the same statistical test was patient's sputum grading for AFB, where the mean rank period for those who have sputum grade of 2 ++ was longer than both with scanty, 1 + or 3 +++.

Table 5.12: shows the relationship between variables related to current illness and post referral period in 130 cases. (For dichotomous variables independent sample t test was performed. For variables with more than 3 subgroups Kruskal Wallis test was used)

	n	Mean ± SD Mean Rank	F/x^2 value	p value
1st symptom related current illness				
Cough	120	4.25 ± 6.72		
Other	10	5.20 ± 8.85	0.015	0.673
Self medication use				
Yes	47	5.06 ± 6.29		
No	83	3.89 ± 7.18	0.812	0.352
Type of 1st HP* visited				
Public	118	4.01 ± 6.33		
Private	12	7.33 ± 10.78	4.578	0.111
Type of investigation performed				
X ray	44	3.93 ± 6.13		
Others	70	3.97 ± 6.45	0.18	0.974
Mode of payment to PH facility**				
Free	36	76.11		
Health insurance	8	31.13	18.466	<0.001
Full payment	74	56.94		
Sputum grading				
Scanty / 1 +	49	57.87		
2 ++	50	79.05	12.177	0.002
3 +++	31	55.71		

* health providers, ** public health

Extra analysis:

For the results where the relationship between dependant and independent variables was significant, file splitting according to possible confounders that could affect the total results was done. Analysis using Kruskal Wallis test for independent variables with 3 or more subgroups or independent sample t test for dichotomous variables was performed. Table 5.13 below shows the results.

Table 5.13: Summary of the relationship between dependant and independent variables

Variables	Periods					
	Total diagnostic	Patient	Total H. system	Other health providers	TBMU	Post referral
Age	* ↓ >54 years, M	* ↑ 25-54, M	-	-	* ↓ 25-54	** ↓ <25
Sex	-	-	* ↑ F	* ↑ F	-	-
M. Status	* ↑ D&W,M,25-54Y,<100$	-	* ↑ D&W, M, 25-54Y,>100$	* ↑ D&W, M, 25-54Y,>100$	-	* ↑ D&W, M, 25-54Y, >100$
Education	-	-	-	-	-	** ↑ < 6Y
Occupation	-	-	* ↑ St & WI, 1+	* ↑ St & WI, 1+	-	-
Monthly income	* ↑ >100$, Sc,1+ or 3+	-	* ↑ >100$, Sc,1+ or 3+	* ↑ >100$, Sc,1+ or 3+	-	-
No. persons/room	-	** ↓ ≥2/ room	-	-	* ↓ ≥2/ room	NA
Residence	-	-	-	-	NA	** ↑ rural
Distance to TBMU	-	* ↑ > 30 mi	* ↑ 15-30 mi	-	** ↑ 15-30 mi	-
Type of investigation performed	-	NA	** ↓ X- ray	NA	NA	-
No. of HP visited before TBMU	* ↑ >1, M	NA	* ↓ >1, HI, Emp	* ↓ >1, HI, Emp	NA	NA
Mode of payment to PH facility	* ↑ Full,M,<25	-	* ↑ HI or Full,M,3+	* ↑ HI or Full,M,3+	-	* ↑ Free, M, Married
Sputum grading	-	* ↑ Sc,1+, F, 25-54	-	-	* ↑ 2+,M, <100$, Married	* ↑ 2+, M, <100$/ 2+,rural, <100$

Key: - p >0.05; * p value ≤0.05 and ≥0.01; ** p < 0.01; ↑ = period increased; ↓= period decreased; NA= not applicable; M= male; F= female; D&W= divorced and widow; Y= years; St & WI= student and without income; sputum grading: Sc= scanty, 1+, 2+, 3+; mi = minutes; HI= health insurance; Emp = governmental employees; Full= full payment to public health facility.

6. Discussion

Study subjects chose different routs through the health system to reach TBMU (considered the final destination for TB patients). Three subgroups were recognized. A minority of the study subjects came directly to the TBMU (7.9%) while the rest initially chose other health providers (92.1%). From those who went to other health providers (65.3%) were referred to TBMUs while the rest (34.7%) chose to reach TBMU following friends or relatives advices or on their own initiative.

Throughout these routs the interaction of patient's and health system's factors determined the length of different periods described in the result chapter. In our discussion firstly we passed through the dependant and subset of the dependant variable under study, describing it and relating our findings to what is available in the literature. In the second part we discussed the interactions between each one of the independent variables that contributed to a difference in the main or a subset of the dependant variable.

6.1. Dependant variable and it's subsets

Total diagnostic period

The mean total diagnostic period was 69.66 days while the median was 64.5 days. Despite this seems shorter than what was described in Tanzania Mwanza region 136 days (17). These findings were in line with most other studies conducted i.e. in Gambia (60 days) (13), in Botswana (84 days) (18), in Ethiopia (64 days) (19), in India (60 days) (20), in Malaysia (87 days) (21), in Korea (60 days) (22). But it looks far longer than what was in Khartoum (53 days) (23).

Patient's period contributed by 52.6% to the total diagnostic period, while health system's period contributed by 47.4%. This finding is in line with three studies described no significant difference between patient's period and health system's period contribution to the total diagnostic period e.g. Sudan (23), Botswana (18) and India (20). While in most other studies patient's period was the main contributor to the total diagnostic period (19,24,16,17,21,25,26,22,27).

Those who came directly to the TBMU the mean total diagnostic period was short (47.06) compared to the total study subjects. Those who reached TBMUs after referral had almost the same mean total diagnostic period (69.98 days) compared to total study subjects. Finally those reaching the TBMU after visiting other health providers, not referred, had the longest mean total diagnostic period (74.62 days) compared to all other subgroups and total study subjects.

Here we discuss the risk factors for having delay of total diagnosis more than 42 days. From multivariate analysis (binary logistic regression), 87.5% of the study subjects showed a total diagnostic period of more than 42 days (considered as delayed). Compared to a previous study conducted in Khartoum (23) 59% of the study subjects reported total period more than one and half month. Difference in patient's health seeking behavior and health system variation between Khartoum and rural areas could be the explanation.

Whenever other health providers visited, number of health providers visited was significantly associated with a delay for more than 42 days with OR of 7.663. The more the number the more risk to became delay. Other significant risk factors for total diagnostic delay were, being divorced or widow, urban residence and sputum for AFB grade scanty or 1 +. The OR for these risk factors was in range of 0.01- 0.06 which indicated a very low prediction. These risk factors were found also as risk factors for longer mean period. The explanation would be more appropriately discussed under each independent variable in the second part of discussion below.

Patient's period

We defined patient's period as the period in days from the onset of major TB symptoms to the first visit to a health provider. This definition is lacking a very important period lodged within health system's period, namely the post referral period i.e. the period in days from the health provider referred the patient to a TBMU till the patient reached the TBMU. The duration of this period could be affected by many patients' related factors like stigma.

The mean patient's period was 36.61 days, while the median was 30 days. This was far longer than what was documented in Gambia 0.3weeks (13). This comparison does not make sense, however due to the different definitions used. In Gambia patient's period was defined as the total period between the onset of pulmonary symptoms of TB and first consultation to any provider including members of the family. Comparing our results to a

Tanzanian study the patient's period was far less than what they found 120 days (17). Comparing our results with most of the other studies we still within the range of 20 to 60 days reported in most studies. In Ethiopia Addis Ababa (60 days) (19), Botswana (21 days) (18), South India (20 days) (20), New York (21 days) (16), Ghana (28 days) (28), Australia (30 days) (25), London (54 days) (26), Korea (54 days) (22), Vietnam (56 days) (27), Khartoum, Sudan (21 days) (23) and Ethiopia, Amhara Region, (30 days) (29).

It has been suggested many cut-off points for the patient's period between delay and not delay. Some authors considered 30 days as a cut-off point; others choose 42 days or 60 days. Our study we considered 28 days or 4 weeks as a cut-off point for the patient's period. Those with period more than 28 days considered delayed.

We found that 61.6% of the study subjects had a patient's period more than 28days. This is higher than what was described from both Khartoum by Sid Ahmed (23) where 30.6% have patient's period more than one month and the Amhara Region in Ethiopia, 48% (29). This could be explained by the variation in socio economic characteristics and patient's health seeking behaviors between rural and urban areas of Sudan. While for the Ethiopian study the reason was due to variation in definition used. In the Ethiopian study patient's period will end even if the patient consulted a traditional healer. Risk factors for having a delay included having to pay to public health services (OR 2.48), being 25 to 54 years old (OR 0.3) and sputum for AFB grade scanty or 1 + (OR 0.34).

Looking at the patient's period, those who came directly to the TBMUs were having the longest mean period (41.59 days) compared to all other subgroups and total study subjects (M= 36.61 days). Those who reached TBMUs after referral from other health providers were having almost the same patient's mean period as total study subjects (37.45 days). The shortest patient's mean period was recorded by those who reached TBMUs following friends and relatives advices or who came on their own initiative after visiting other health providers (M= 33.8 days).

Total health system's period

Again in our analysis we included post referral period in the total health system's period and more specifically within other health provider's period where it represented 14.5% of the period.

The mean total health system's period was 33.05 days, while the median was 28 days. Comparing these results to studies conducted in Korea, Ethiopia and USA with a mean period of 6 days (16, 19, 22) the mean period in our study was far longer. Comparing it to a Gambian study with 59 days (13) and one from Ghana with 56 days (28) it seemed far less but these variation was due to different definitions used in the different studies. Comparing our results to other studies, Botswana with 35 days (18), South India with 23 days (20), rural Ethiopia with 21 days (29), Australia with 11 days (25), London with 29 days (26), Vietnam with 27-38 days (27) and Sudan with 21 days (23) we did not find a big difference.

Other health providers explained 87.9% of the total health system's period, while TBMU's period explained only 12.1% of total health system's period. This finding is in line with a study conducted in an urban area of Sudan (23).

What is considered as health system's delay? Some studies considered 7 days, 10 days or 14 days as a cut-off point, while other studies put the cut-off point as the median value or specific number of days proposed by physicians according to their experiences. In our study we considered period more than 2 weeks for health system as delayed.

79.2% of the study subjects showed a total health system's period more than 14 days (health system delay). The risk factors for delay were, being married (OR 9.213) and having formal education of more than 6 years (OR 11.532). The explanation for this could be low suspicion of health personnel for those with higher level of education based on social position of educated people within the community.

Total health system's mean period for those came directly to TBMUs (5.47 days) was the shortest compared to other subgroups and total study subjects. The longest total health system mean's period was recorded by those visited other health providers but who were not referred to TBMUs (40.19 days). Those referred to TBMUs by other health providers scored almost the same mean health system's period for the total study subjects (32.54 days).

Other health provider's period

92.1% of our study subjects mentioned visiting other health providers before reaching TBMU. Compared to what was described in Khartoum (23), population in rural areas tended to visit other health providers more than coming directly to TBMU. This could be explained upon the difference of health seeking behavior between both areas. The mean of the other health provider's period was 29.11 days, while the median was 24 days. The same median period was reported in study conducted in Khartoum (23) and Amhara Region in Ethiopia (29). 78.7% of the study subjects showed other health provider's period more than 9 days. This percent is almost the same like total health system's period. It would be clear for strategies targeting the decrease of health system's period to focus on this part.

TBMU's period

The mean TBMU's period was 3.99 days and the median was 4 days which was similar to what was described in urban area of Sudan (23).

14.8% of the study subjects showed a TBMU's period of more than 5 days while 85.2% got diagnosed and initiated treatment within 5 days from their first contact with the TBMU. The existence of two national vacations (4 days and 5 days) during data collection period had its contribution to this percent.

Post referral period

Almost all studies included this period in the health system's period; this made comparison to relevant literature impossible. If we want to increase the efficiency of the referral system, we need to focus on post referral delays and factors influencing it. After referral to TBMU, patient's factors play major role in determining the duration of this period.

TB services are for many people associated with TB sanatoria with long admission and social stigma. Worrying for the family income during a long treatment period may also plays a role in making patients hesitate to contact TBMUs. A health system related factor which could contribute to this period is the health financing system. TB management in Sudan is free. Health facilities were not allowed to take money from TB patients or TB suspects after referral to TBMU. This could stimulate health facility to delay referral.

This period can vary among different patients. In our study it was from 1 to 30 days. The mean post referral period as calculated for the 130 subjects reached TBMU after referral was 4.32 ± 6.87 days. Despite this mean looks short compared to the total diagnostic period, it is still equivalent to the TBMU's period.

Studies will take place to evaluate new diagnostic tool for TB as a strategy to decrease health system's period, should put on consideration this period. Here it was short compared to total health system's period, but when the scale of measurement change due to a successful strategy, this period can change the whole evaluation measurements.

6.2. Independent variables

Age

With the mean age of 36.43 years and domination of the age group between 25 and 54 years (62.5%) this findings are in line with both global and national notification data of new smear positive pulmonary TB cases (7, 11). This indicated that TB is still affecting those in productive and reproductive ages mainly when considering age of TB patients in study area. The implication of this could be understood on the bases of "When a poor or socially vulnerable person becomes ill or injured, the entire household can become trapped in a downward spiral of lost income and high health care costs" (34).

Age was of no relevance for the total diagnostic period. The same findings were described in Korea (22), and Nepal (32), where the total diagnostic period did not differ by age. When male and females were analyzed separately, older males were found to have a shorter total diagnostic period compared to males younger than 54 years old. This could be explained by looking at the social construction of extended families where older males are considered the leaders of the family. This kind of leadership is based upon the idea of give and take. The leader gives advices, represents the whole family in social events and organizes the harmony of family member's dynamics. In return the other family members obey and take care of the older male (5).

For those in the middle age, the role of females is mainly based on domestic activities. For the male securing financial resources and balancing limited resources with expenditure is the main activity. While for those younger schooling and supporting those in the middle age during vacations seems to be the only available role to be played. For males 25-54 years old having the longest patient's period an explanation could be: Health care seeking was of less priority until the illness becomes an obstacle for the role they play within the family. This finding is in contradiction with other studies found significantly longer patient's period in older age groups like in India and Tanzania where a longer patient's period was associated with age more than 45 years (20,17) and New York City, USA, where age 55–64 years was associated with longer patient's period (16).

The finding of shorter TBMU's period for those between 25-54 years old could be explained by the TBMU's health personnel having a higher degree of suspecting TB as a cause of cough for this age group.

Males and females under 25 years old were found to have the shortest post referral period compared to the other age groups. This reflected the type of care provided to younger members within the family since they represent the future maintenance for the family.

Gender

The domination of males (63.4%) being notified as TB cases compared to females (36.6%) is in line with a study conducted in urban Sudan (23) and national notification rate (11). The explanation for this could be either lower prevalence of TB among females or lack of equality and/or equity in accessing health provision. "Poor women and girls may experience a deeper disadvantage in access to resources for health, such as cash and financing schemes, services, and voice, some categories of women are especially vulnerable – for example elderly widows and unsupported females" (35).

Gender variation did not play any role as a factor determining the duration of total diagnostic period. The same was documented in other studies (13, 19, 26, 18, 31, 21, 22, 34, 24).

For the total health system's period and other health provider's period, females showed a longer period compared to males. The same finding was reported in Vietnam, Australia and Ghana, where health system's period was significantly longer for females (27, 25, 28). The exact difference was: for singles, those who visited 2 to 4 health providers before reaching the TBMU and having sputum for AFB grade 1 + or scanty. For married, those with one or less other health providers visited before reaching the TBMU and sputum for AFB grade 2 ++. Social consequences on females after being diagnosed as TB patients could be the explanation for this phenomenon. As described in rural Vietnam, divorce for married women would occur (27). For single female chances to get married would decrease. Another explanation for single would be the lower suspicion index of other health providers for younger with mild form of TB disease as measured by sputum grading for AFB.

In contradiction to what was reported from the Khartoum study (23), TBMU's period did not show any difference for sex.

Marital status

The majority of the study subjects were married 63.4%. This could be explained compared to the percentage of those in the reproductive age (62.5%).

Divorced or widows showed a longer total diagnostic period compared to married. This difference was for divorced or widowed males between 25 to 54 years old with monthly income more than 100 US$. The same pattern appeared for total health system's period, other health provider's period and post referral period. These patients spent a longer period within the health system despite they did have a higher income compared to other study subjects. This may be explained through linking it to the bases on the male leadership role within the community, and thus, the visits to avoid TB diagnosis.

Education

Despite the domination of study subjects with less than 3 years of formal education (46.3%), years of education were not significantly different for any of the periods when means of period was analyzed. Formal education did not seem to affect the person's health seeking behavior towards TB.

The only exceptional period was for the post referral's period. Having formal education of less than 6 years was associated with a longer post referral period. Social stigma against TB for those with education less than 3 years could be the explanation for this.

Occupation

Students and those without income generating activities were 43.1%. 7.6 % of females in the study subjects worked as farmers while 92.4% were students or without income. Culturally in the study area a women's job is domestic activities. Among males, the majority were farmers and laborers (43.1%). Looking at the socio economic background of the community under study, we found that males tended to have such kind of jobs as a transitional profession to overcome some economic crises that lead to their loss of their nomadic life some found the new life more stable and they settle (5).

A long total health system's period and other health provider's period for students and those without income generating activities when compared to government employees was observed. The real difference was for those with sputum grade for AFB of scanty or 1 + compared to other higher sputum grades.

As described in the Khartoum study, governmental employees were having shorter patient's period compared to farmers (23) explained by the author as a possible result of difference between rural and urban residence. Here we could not find this type of association for any period.

Family monthly income

Having a monthly income less than 100 US$ applied to 65.7% of study subjects, this support the key finding from the individual/micro-level researches i.e. there is a very clear and very robust relationship between individual income and individual health (36).

From our results, higher income was associated with longer total diagnostic period, total health system's period and other health provider's period. Sex difference or number of health providers visited did not change the results. Sputum grading on the other hand played a significant role. Those with sputum for AFB grade scanty, 1 + or 3 +++ showed shorter periods compared to grade 2 ++. It would be easy to explain the long health system's period for those with 1 + or scanty results when considering TB suspicion of other health providers for a milder form of TB presented in a person with high income. To explain the long diagnostic period for those with sputum grade 3 +++, a social aspect may be included where stigma for TB could be the explanation for not visiting TBMU earlier until the disease became very sever.

Number of persons per room

57.4% of study subjects were living in houses with one to two rooms; Most of the study subject's houses were shared by 7 to 9 persons (34.7%). 57.4% of the study subjects were living in houses where 2 to 3 people share the same room, while 38.9% shared the room with other 4 or more people. This finding could give us a clue on the size of TB transmission among the family member. According to H.L. Rieder two of the three major factors that determine the risk of becoming exposed were the number and nature of interactions between a case and a susceptible contact per unit of time of infectiousness and the duration of the infectiousness. Factors that determine case-contact interactions include family size and social arrangement within the family (9).

For patient's period and TBMU's period, sharing the room with more than 2 other persons was associated with a shorter period compared to living in one room alone. These findings reflect the type of care provided between the household members. Others influence ones life within the extended family, where the benefits of all depend on the contribution of each member. Social stigma toward TB are influenced by, the infectiousness of the disease and curability. With the available knowledge in the community on symptoms and curability of TB, members of the family will act by promoting diagnosing and curing the sick member. This was reflected in shorter patient's period and TBMU's period.

Residence

From census estimations, 77% of the population in the state was rural. In our study we found 73.6% of the study subjects reside in rural areas. This indicated that the notification of TB among different residences was even and there was no over notification from urban than rural residences.

Despite few studies have compared rural and urban populations, all studies available found that rural TB patients had longer diagnostic period than urban patients. Botswana (18), Ghana (28), Korea (22), Gambia (13) and Tanzania (17) the total diagnostic period was significantly longer in rural areas than in urban areas.

From our results, rural and urban residents showed no difference for total diagnostic period, patient's period, total health system's period, other health provider's period and TBMU's period. The explanation for this could be socio demographic homogeneity of the study subjects. The urban population of the study subjects were originally derived from the rural population "Rural Sudanese have recently moved to cities, but still they have a strong continues relationship to where they came from" (5).

The only exceptional finding was for post referral period. Rural residents showed longer period than urban residents. For female it was linked to being single and younger than 25 years old. For males it was linked to formal education of more than 6 years. The explanation could be related to social stigma against TB. For females chances for getting married would decrease if they have TB. For males social position or interaction would change.

Distance to TBMU

Despite the decentralization of health services and 100% DOTS coverage of TB services in the state, still 45.4% of the study subjects reported more than 30 minutes distance between their living and the TBMU. This could be explained by the tendency of TB patients (social stigma) to seek health care away from the nearest TBMU.

For the patient's period, those who lived more than 30 minutes walk from a TBMU showed a longer period compared to those lived nearer. Same finding was described in India, Zambia and Ethiopia, (19,20,31) where longer distance was associated with longer diagnostic periods. The common explanation for this is accessibility, when ever health service is near to patient's residence patient's period became short and vice versa.

For both total health system's period and TBMU's period, those who lived between 15 to 30 minutes walk from a TBMU showed longer period compared to those lived less than 15 minutes or more than 30 minutes walk. This difference was only for those resident in rural areas. To explain both findings, health care provider's factors should be excluded. Considering only patient's health seeking behavior, patient's tendency to spend long time within the health system before final diagnosis could make TBMU's period longer. The mean TBMU's period was short; additional few extra days would make the difference significant. For more understanding patient's health seeking behavior should be studied for those satisfy this situation.

Type of investigation performed before reaching TBMU

Here we were comparing the use of chest X-ray versus blood investigations. From the 60.2% of the study subjects referred by other health providers to the TBMU, the majority have chest X-ray before referral. While the majority of those came to the TBMU following their own initiative reported blood investigations performance. This reflected the gap of standardization in investigations to be performed for TB suspect.

Performance of chest X-ray was associated with shorter total health system's period compared to blood investigations. One explanation could be X- ray was performed to those with clear symptoms of TB, while blood investigations were performed to those with more complicated symptoms. In this situation, despite short health system's period, other health providers should go for sputum microscopy for AFB if the patient had cough more than two weeks. Other explanation based on personal experience from working for the NTP, erythrocytes sedimentation rate (ESR) was mistakenly over used by medical assistant as a diagnostic test for TB. ESR with more than 3 figures was considered diagnostic for TB while less than that was considered exclusive. In such situation we would expect longer total health system's period for those who received blood investigation.

Number of other health provider's visited before reaching TBMU

92.1% of the study subjects had consulted at least one other health providers before coming to the TBMU. Females tended to visit a higher number of health providers than males and this difference was statistically significant. The same finding was described in a Vietnamese study (27). The same explanation described by the Vietnamese study could be valid in our situation i.e. to be a female with TB is one of the reasons behind divorce or separation from the family. The modulation occurred on health seeking behavior could be avoiding TB diagnosis through justifying cough by more frequent visits to different health providers.

From the results chapter, it was clear whenever the number of other health providers visited increases the total health system's period, other health provider's period and consequently total diagnostic period increased.

For the total diagnostic period, this significant difference between different number of other health providers visited was only associated with male gender. This may be a reflection of the different types of health seeking behavior related to both TB and gender in our study subjects. For total health system's period and other health provider's period those covered by health insurance and who work as governmental employees showed shorter periods compared to other types of mode of payment to the public health facility and occupations. All government employees were covered with health insurance. The only explanation for this finding could be the variation in the attitude and practice of health personnel working for health insurance and those working for other public health facilities.

Mode of payment to public health facility

Paying the full fee for the public health facility was associated with longer total diagnostic period, total health system's period and other health provider's period. Total diagnostic period was longer for those paid full fee for the public health facility, males and younger than 25 years old and compared to females, other age groups and those covered by health insurance or did not pay. Total health system's period and other health provider's period was longer for those covered by health insurance or paid full fee for public health facility, males with sputum for AFB grade 3 +++, compared to females, other sputum grades and those have the service free. It would be much more clear if we stated in other way; even if there were no financial barriers for health services, still patient's health seeking behavior can contribute to the duration of health system's period.

Post referral period was longer for those paid nothing to the public health facility, males, married, those with sputum for AFB grade 2 ++ or 3 +++ compared to females, other marital status, other sputum grades and those covered with health insurance or paid full fee. This could be explained by looking at the prospect of a male having a family, being severely ill and referred to TBMU, admission to the hospital and long stay would be expected. Before coming to the TBMU, family and financial arrangement should be performed. This was reflected in a long post referral period.

Sputum grading

Patient's period was longer for sputum grade for AFB scanty or 1 +, females, married and 25 to 54 years old compared to males, other marital status, other age groups and higher sputum grades. This could be explained if we accept sputum grading as a measurement of severity of TB disease. With milder forms of the disease patients tend to ignore or confuse TB symptoms with other respiratory illness which need no health facility consultation.

TBMU's period was longer for sputum grade for AFB of scanty or 1 +, males, married and with monthly income more than 100 US$ compared to females, other marital status, other income and other sputum grades. There are two possible explanations. Firstly sputum microscopy of sputum for AFB is with low sensitivity especially if the number of TB bacilli was scanty or 1 +. Accordingly based on the results the TBMU's period can be short or long. Secondly patients with higher income are at least suspicion for TBMU's personnel compared to poorer. This on the other hand could be a reason for long TBMU's period.

Post referral period was longer for sputum grade for AFB of 2 ++, males and with monthly income less than 100 US$ compared to females, other income and other sputum grades. It was also longer for sputum grade for AFB 2 ++, rural residents and with income less than 100 US$ and. The same explanation given above under mode of payment to public health facility could be valid here.

7. Conclusion

In our study which was a cross sectional study 216 new smear positive pulmonary TB patients were recruited from an almost rural setting. According to four dimensions of poverty namely; economic (income, housing condition, occupation), human (health, education), socio-cultural (status, gender) and protective (age), study subjects were poor. More over, socio-cultural beliefs on men and women in the community were contributing to more gender variations.

The impact of TB control programme in the study area was reflected on the elevation of knowledge about TB symptoms and a short TBMU's period. Still the majority of TB patients suffer from a long undue period before diagnosis and commencement of treatment. The main reasons behind this were influenced by both patients and health system's factors.

For the patient's socio demographic characteristics, age, mode of payment to public health service, patient's housing conditions and distance to the TBMU were found to be associated with difference within each group of the socio economical characteristics. Other characteristics like sex, marital status, occupation, education and residence were not found to have any impact. The severity of the disease as measured by sputum grading for AFB was found to be a factor in determining the total patient's period.

Concerning health system's period, for accuracy in interpretation of results was divided into other health provider's period and TBMU's period. For the former period some of the patient's socio demographic characteristics namely gender, marital status, monthly income and distance to the TBMU were found to have a significant impact on the other health provider's period. Other factors including mode of payment to public health facility, type of investigation performed before reaching TBMU and patient's sputum grading for AFB was found contribute to the duration of the period. For the TBMU's period only age of the patient, housing conditions and distance to the TBMU were found to be the patient's socio demographic characteristics with a significant influence on the TBMU's period, while sputum grading for AFB was found to be significant.

Dividing diagnostic period into patient's and health system's periods is very common in many studies. In reality it would be impossible to be done. Patient's health seeking behavior can modulate the duration of health system period. On the other hand health system barriers can also modulate the patient's period. An example for this overlapping of the two periods was clear, referring to what we called post referral period. Despite in our study we highlighted few aspect of this overlapping, it would be more appropriate for future studies to consider this factor.

8. Recommendations

1. Studies focusing on exploration of socio demographic factors contributed to longer patient's period should be conducted before implementing any operational activities to shorten patient's period.
2. A coordinated involvement of all health providers against TB fighting based on national and international guidelines should take place in the near future.
3. Despite the idea of new diagnostic tool for TB with high sensitivity and specificity seems promising in shortening health system's period, more studies should be conducted focusing on more exploration of factors that can create overlapping between patient's and health system's periods like post referral period.
4. Poverty reduction policies should be taken seriously by the government since it will contribute to reduction of TB total diagnostic period.

9. Annexes

9.1. Annex 1

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9.2. Annex 2

Questionnaire

Delay in the diagnosis and treatment of new smear positive pulmonary TB in Gaziera State.

Respondent number …………../………… Date of filling ………../…………../2005

1. Age: …………………..Years

2. Sex: Male ☐ Female ☐

3. Education level (number of formal education in years)

Less than 3 years ☐ 3-6 Years ☐ 6-12 Years ☐ More than 12 years ☐

4. Marital status

Single ☐ Married ☐ Widow ☐ Divorced ☐

5. Where do you live (name of city or village): ………………………

6. Occupation: ………………………………..

7. Family monthly income:

< 260,000 LS ☐ 260,000-520,000LS ☐ > 520,000LS ☐

8. Number of rooms in your house: ………………….

9. Number of persons sharing the same house with you: …………………..

10. Distance from home to this health facility walking by foot

<15 minutes ☐ 15-30 minutes ☐ > 30 minutes ☐

11. What was/were the first symptoms that you had experienced that was/were related to your current illness?

Cough ☐ Loss of weight ☐ Sputum production ☐

Chest pain ☐ Fever ☐ Night sweating ☐

Tiredness ☐ Haemoptysis ☐ Others ☐

12. When was that in days?

<14 days ☐ 15-41days ☐ More than 42 days ☐

13. If more than 42 days then specify in days or months …………………………

14. Have you tried self-medications?

Yes ☐ No ☐

15. If yes what type of medications you used? ……………………………………..

16. What was the time period between the appearance of your first symptoms and your first visit to medical provider? …………………………… Days.

17. What type of medical provider you first visited?

Private clinic ☐ Public health facility ☐

Pharmacist ☐ Others (specify) ☐ ………………….

18. If it was public health facility, what was the mode of payment:

Health insurance ☐ Free ☐ Full payment ☐

19. Before reaching this center how many health providers you had consulted?..

20. What investigations (if any) were performed by those providers?

Chest X-Ray ☐ Blood ☐ Sputum ☐ Others ☐

21. If sputum was done what was the result?

Positive ☐ Negative ☐

22. What was the diagnosis, if any? ……………………………………………………..

23. What type of medications you received, if any? ………………………………..

24. How did you reach this TB centre?

Referred by my medical provider ☐ Advised by a friend or relative ☐

Came on my own ☐ Other (specify)…………………. ☐

25. If referred by medical provider, how many days it took to reach this TB centre?......................... days.

26. How long it took you to reach this TB centre from your very first visit to a medical provider? ……………………………………days.

27. Which of the following investigations was/were performed in this TB centre?

Sputum ☐ Chest X-ray ☐ Others ☐

28. How long it took from your first presentation in this TB centre until they requested sputum examination? ……………………………Days.

29. How long it took from request of sputum examination until you got the sputum results? ………………………………………………Days.

30. If the period between requesting sputum examination and result collection was more than 3days, what did you think was the reasons behind this? ………………………………………………………………………………..

31. Date of the collection of the first sample of sputum examination (from the TB laboratory register book? Day ………../ Month …………….

32. grading of sputum result (from LRB):

Scanty ☐ +1 ☐ +2 ☐ +3 ☐

33. Date of registration at the TB district register book: Day…………/Month ………..

34. Date of start of treatment (from patient treatment card): Day………. / Month………

9.3. Annex 3

CONSENT FORM

Introduction:

My name is Ammar Salih Mohammed, currently, I am studying International Community Health in Norway and this research is part of the study. I am interviewing both men and women to study delay in diagnosis and treatment of new smear-positive TB. This study will be conducted in Khartoum state.

Confidentiality and consent:

"I'm going to ask you some questions, some of them are personal like your age and your education, and so. Some question will be about your disease. These questions are too general but we, my assistant and me will ensure complete confidentiality of your answers. Your name will not be written on this interview note or anywhere else, and will never be used in connection with any of the information you tell me. You do not have to answer any questions that you do not want to answer, and you may end this interview at any time you want to. However, your honest answers to these questions will help to understand this problem.

I would greatly appreciate your help in responding to this interview. Would you be willing to participate?

If you agree to participate please sign here.

Signature: ……………………………………………………………

9.4. Annex 4

Diagram shows the relationship between total diagnostic period and other periods: